RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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Histopathologic Effects of X-Rays, Radiophosphorus, Nitrogen Mustard, Urethane, and Steroids upon the Spleen in Leukemias and Lymphomas[1]

MATTHEW BLOCK, Ph.D., M.D.

PRACTICALLY ALL prior investigations of the effect of therapy upon the spleen of patients with leukemias and lymphomas have been limited to studies made at autopsy. It is the purpose of this paper to investigate the histopathologic effects of treatment of these diseases by comparing the morphology of biopsy specimens obtained following treatment with a control biopsy obtained immediately prior to therapy.

MATERIALS AND METHODS

Technic: Biopsy of the spleen was performed with a Vim-Silverman needle by transthoracic or transabdominal route (1). A piece of tissue about half to two-thirds as thick as the lead in a pencil (1 mm.) and varying from 1 to 3 cm. in length (usually 2 to 3 cm.) was obtained. The larger spleens were biopsied transabdominally, since this is probably safer in the thrombopenic patient, a category into which most of the cases fell. There were no serious complications except for a temporary fall in blood pressure in a single instance.

Splenic tissue was prepared by the Maximow technic: Immediate Zenker-formol fixation, sectioning at 6 micra in nitrocellulose, and staining by hematoxylin eosin azure II (2). Slides were also stained for iron (3), and for connective-tissue fibers by the Mallory-azan technic (4). A small piece of tissue was removed from each biopsy specimen for preparation of dry smears by the abklatch technic (5, 6), in which a piece of spleen is gently touched between two slides. These slides were colorized by Wright's stain. *All specimens were examined as unknowns and an objective description was made of the microscopic findings. The latter served as a basis for the conclusions drawn in this study.*

Smears of splenic tissue were not only useless but often misleading, the most important reason being errors inherent in this technic. A multilayered mass of cells with twisted fibers was found wherever the spleen was touched (abklatch of Downey) or smeared on the slide or cover-slip. Because of distortion or opaqueness, the more immature cells, reticular and stem cells, in this mass could not be studied. As a result, only the more mature cells at the periphery of the splenic "touch" or abklatch were available for study. Mitotic cells and nuclear débris were never seen in the

[1] From the Division of Laboratory Medicine, Department of Medicine, University of Colorado School of Medicine, Denver, Colo. Supported in part by the Jill Garnsey Memorial Fund and Sarah Weltman Memorial Fund.
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smears. A second reason was that it was impossible to determine which type of splenic tissue (normal white or red pulp, fibrous tissue, or tissue specifically involved in the malignant process) was studied. Consequently it was impossible to be certain whether changes seen in smears of repeat biopsies were due to differences in the type of tissue being sampled or to the effect of treatment.

Comparability of Biopsies: A study such as this depends upon the comparability of the tissue obtained in sequential biopsies. In the leukemias the spleen has a sufficiently uniform appearance so that this is not a major problem. Serial biopsies from a lymphomatous spleen, however, may vary. Each biopsy may contain a different amount of white or red pulp, or lymphomatous tissue, or one biopsy may consist exclusively of one tissue while the next is made up of many or a single different tissue. In order to obviate any errors arising from this complication, only comparable areas were evaluated as to the effect of treatment, a precaution which is obviously impossible where sole reliance is placed upon smears of aspirated splenic tissues.

Treatment: The following treatment factors were used for patients given x-ray therapy. A 250-kv x-ray machine, 30 ma, was used at 50 cm. treatment distance, with a Thoraeus II filter. The portals varied from 10 × 10 to 20 × 20 cm. All doses are calculated as roentgens delivered at 7 to 8 cm. below the surface of the skin.

Radiophosphorus was administered intravenously. Other patients were treated with steroids, nitrogen mustard (HN2), urethane, and in a few instances by a combination of these modalities. No patient received any other treatment except blood transfusions.

The clinical management of each patient was under the author's direct supervision.

Selection of Patients and Time of Biopsy: Splenic biopsy is a potentially dangerous procedure with hemorrhage a major complication. This consideration eliminated many cases in which a biopsy would have been desirable and so biased the selection of patients in favor of those in whom the procedure was safe. However, by utilization of the transabdominal route and application of a sandbag to the biopsy site, it was possible to include patients in whom spleen biopsy would be considered too dangerous according to commonly accepted contraindications (5, 7). Had these contraindications been followed, two-thirds of the patients in this study would have been eliminated. Further bias in selection was exerted in that only those patients with palpable spleens were studied.

Biopsy was performed within a few hours prior to the initiation of treatment. For example, patients treated by irradiation of the spleen were biopsied in the morning, treatment was begun in the afternoon, and succeeding biopsies were obtained at varying intervals after irradiation.

Criteria for Remission: In order for a patient to be classified as undergoing a good remission, objective signs of clinical and hematologic improvement had to be demonstrable. Clinical evidence considered acceptable included weight gain without edema, cessation of fever, decrease in size of abnormal masses, and return to a useful way of life. Alleviation of anemia and return of the differential white count and of platelets to a normal value were acceptable as criteria of a hematologic remission. A fall in the white count and decrease in splenic size were not, in themselves or in combination, considered acceptable evidence of a remission.

RESULTS

X-ray Therapy (Table I)

Hodgkin's Disease: One terminal patient (Case I), previously intensively treated with x-rays and nitrogen mustard, was studied. He received 640 r through a 10 × 15-cm. portal during ten days. A remission was not obtained nor did the spleen become smaller, although the white count fell from 3,200 to 1,900. Prior to treatment (Fig. 1, A) the biopsy showed fairly normal red pulp with a marked

TABLE I: SPLENIC X-IRRADIATION

Patient	Prior Treatment	Other Treatment	Remission	Comments
1. Jo. Ha. Male, 33 yr. Hodgkin's 8 yr.	X-ray from 8 to 2 yr. ago. Nine courses of HN2 in 2 yr., last given 6 weeks earlier	Repeated transfusions to keep hemoglobin over 15.0	None; death within 6 weeks	Terminal at time of study
2. Ly. Zi. Female, 28 yr. Lymphosarcoma 18 mo.	Splenic x-irradiation followed by 6 mo. of P^{32}, last dose 7 mo. ago	Splenectomy; one transfusion	Cannot evaluate because of splenectomy	Died; thrombosis of splenic vein
3. Al. Wa. Female, 67 yr. Lymphosarcoma 17 yr.	X-ray 17 yr. and 6 to 4 yr. ago; 1,400 r(air) to spleen 18 mo. ago	None	Progressive deterioration and oral ulcerations	In 8 mo. prior to study developed subacute lymphatic leukemia
4. Jo. Bo. Male, 78 yr. Chronic lymphatic leukemia 8 yr.	No treatment 5 yr.	None	Cannot interpret; only one treatment	No response to splenic irradiation 4 mo. later. Died in 4 mo.
5. Ab. Ba. Male, 66 yr. Chronic lymphatic leukemia 4 yr.	Splenic x-irradiation for 4 yr.; repeated 16 mo. ago	None	None	Moribund at time of study. Suicide 8 mo. later
6. Ra. Os. Male, 47 yr. Chronic lymphatic leukemia 8 mo.	None	None	Cannot interpret; only one dose	Later had good response to P^{32}
7. Ea. Ba. Male, 18 yr. Chronic myelogenous leukemia	None	None	Good	Early treatment, sensitive stage
8. Ed. Br. Female, 74 yr. Chronic myelogenous leukemia 1 yr.	None	None	Poor; white count fell to 9,550 on completion of therapy	Died of persistent anemia and thrombopenia refractory to all treatment
9. Ma. Ro. Female, 27 yr. Chronic myelogenous leukemia 9 mo.	P^{32} 6 mo. earlier	Repeated transfusions	None; death in 14 wk.	Change to acute myleogenous leukemia prior to x-irradiation

hemosiderosis and an average amount of karyorrhexis. Mitoses were not seen.

The first posttreatment biopsy, obtained eight hours after the first of the eight doses of 80 r, was composed primarily of specific Hodgkin's tissue with numerous mitoses (Fig. 1, B). Since there was no comparable area in the pretreatment specimen, it was impossible to determine if the number of mitoses had decreased. It was obvious that treatment had not inhibited mitotic proliferation nor had it eliminated the specific Hodgkin's lesion.

The biopsy obtained sixteen hours after the fourth dose of 80 r to the spleen contained tissue comparable to the pretreatment biopsy. There were only minute changes of questionable significance, as, for example, a lesser degree of protrusion of sinus endothelium into the lumen of the vessel. As in the pretreatment biopsy, no mitoses were seen.

Lymphosarcoma: One patient (Case 2), with a lymphosarcoma and secondary hemolytic anemia of eighteen months duration, was studied. About eighteen hours prior to splenectomy 240 r was administered through a 7.5 × 7.5-cm. portal to the lower pole of the spleen. Comparison was made of tissue obtained from irradiated and nonirradiated areas. The untreated area contained an exceptionally large amount of nuclear débris, most of which was concentrated in white pulp. In the irradiated area there was a minute increase in nuclear débris, restricted largely to white pulp. Mitoses were not found.

Because of the close similarity of the two

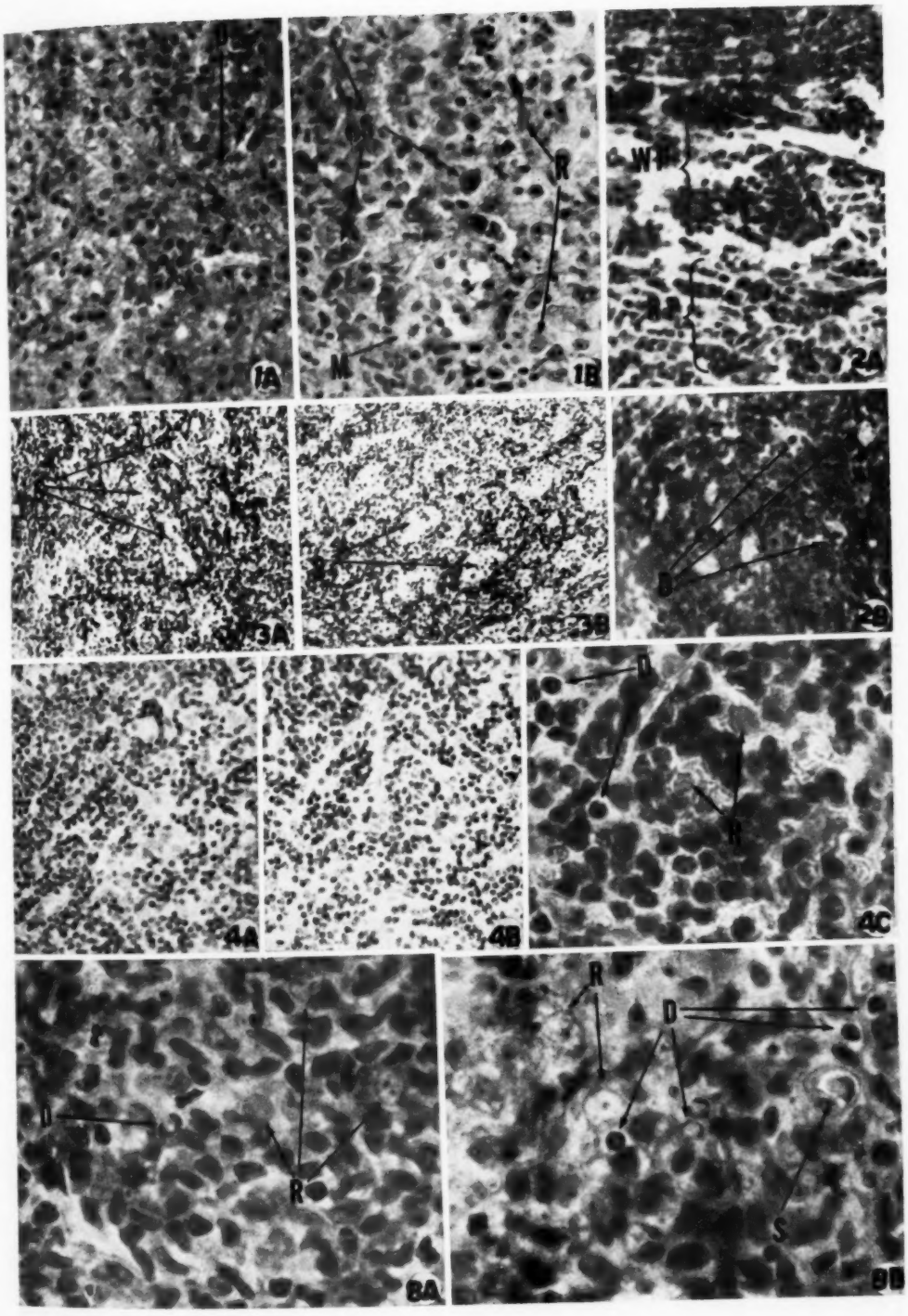
Fig. 1, A and B. Case 1: Hodgkin's disease.
A. Prior to treatment. Normal red pulp, nuclear débris (D). ×165.
B. Eight hours after 80 r: specific Hodgkin's tissue with intact Sternberg-Reed cells (S), reticular cells (R), mitoses (M). Area not comparable to Fig. 1A. ×165.

Fig. 2, A and B. Case 3: Lymphosarcoma developing into acute lymphatic leukemia.
A. Prior to treatment. Distortion of splenic architecture by diffuse sheet of medium lymphocytes in white pulp (WP), less concentrated in red pulp (RP). ×165.
B. Sixteen hours after 523 r: nuclear débris (D) of medium lymphocytes focalized about intact reticular cells; white pulp. ×80.

Fig. 3, A and B. Case 5: Terminal chronic lymphatic leukemia.
A. Prior to treatment. Fairly normal architecture with recognizable sinusoids (S). ×80.
B. After 240 r. Similar to Fig. 3A except for more open sinusoidal structure (S) of red pulp. ×80.

Fig. 4, A–C. Case 6: Previously untreated chronic lymphatic leukemia.
A. Prior to treatment. Dense lymphocytic infiltrate. ×165.
B. Eighteen hours after 400 r. Similar to Fig. 4A. ×165.
C. Higher power of B. Karyorrhexis of small lymphocytes (D); normal reticular cells (R). ×495.

Fig. 8, A and B. Case 14: Hodgkin's disease.
A. Prior to HN2. White pulp with one degenerating lymphocyte (D) and reticular cells (R). ×495.
B. Sixteen hours after HN2. White pulp with increased nuclear débris from small lymphocytes (D); intact but swollen reticular cells (R). ×495.


1A
M
R
1B
WBC
RBC
2A
3A
3B
D
2B
4A
4B
D
R
4C
D
R
8A
R
D
S
8B

specimens, it was thought that both had been obtained from the irradiated portion of the spleen. There were two facts that militated against this interpretation. Care was taken to obtain splenic tissue several centimeters outside of the calculated margin and also within the projection of the x-ray portal upon the spleen. A spleen biopsy obtained approximately eight months prior to splenectomy showed an unusually large amount of karyorrhexis, indicating that this was a biologic characteristic of the disease in this instance. Using a similar technic but larger dose, Windholz (8) was able to demonstrate marked karyorrhexis in the irradiated area of the spleen.

As will become more apparent, there are marked differences in the amount of cellular degeneration and numbers of mitoses in the spleens of patients with the same disease, further emphasizing the need for an adequate pretreatment biopsy to serve as a baseline for evaluation of the effects of treatment.

In Case 3, in a 67-year-old female with a history of lymphosarcoma of seventeen years, no therapy had been given since a course of 1,400 r (in air) to the spleen about eighteen months prior to this study. During the major part of the seventeen years this patient had been asymptomatic. In recent months she had become febrile and lost weight, and had exhibited an anemia, thrombocytopenia, and white count of 254,000, practically made up solely of medium lymphocytes (lymphoblasts). This case therefore represents a transition from lymphosarcoma to subacute or acute lymphatic leukemia.

The pretreatment biopsy was so densely packed with a monomorphous sheet of medium lymphocytes that the normal histology of the spleen was almost entirely obscured (Fig. 2, A). The rare degenerating cells and mitoses were limited primarily to what was thought to have been white pulp.

At sixteen hours after a single dose of 523 r through a 20 × 20-cm. portal, there was a minute but significant increase in lymphocytic karyorrhexis. At least three-quarters of this nuclear débris was phagocytized by reticular cells in the white pulp and was not spread diffusely through the spleen (Fig. 2, B). Except for this phagocytosis, there was no change in reticular cells. No mitoses were found.

Within two and two-thirds days after this single dose of 523 r the number of lymphocytes in the spleen was moderately decreased, especially in the white pulp. The increased cellular degeneration apparent at sixteen hours after treatment had disappeared, so that there was no more nuclear débris than in the pretreatment biopsy. No mitoses were seen.

At twelve days after the initial dose and twenty-three hours after the last of four daily treatments totaling 270 r through the same portal, the spleen had returned to approximately its pretreatment appearance. Mitoses and degenerating cells were seen in approximately the same number as prior to irradiation. The total cellularity was slightly reduced, primarily due to a decrease in the number of medium lymphocytes. There was, however, no change in the appearance of the lymphocytes.

In the twelve days between the pretreatment and third posttreatment biopsy, during which time only x-ray therapy was given, the white count and differential were unchanged and the hemoglobin dropped slightly. Although the size of the spleen receded by about 4 cm., the patient's condition became worse, with severe oral sepsis, anorexia, and pronounced malaise. Her further course will be detailed under the effect of steroids.

Chronic Lymphatic Leukemia: The first two patients (Cases 4 and 5) studied were in a terminal phase of their disease.

In Case 4 biopsy was done prior to and forty hours after a single dose of 172 r through a 15 × 15-cm. portal. The clinical response cannot be evaluated, since only this one treatment was given. Four months later, however, the patient failed to respond to a course of 250 r to the spleen, dying before treatment could be completed.

Both biopsies consisted of dense sheets of small lymphocytes which obscured all architecture except for the trabecular structure. A most unusual finding for chronic lymphatic leukemia was the presence of scattered myelocytes throughout both specimens. The only significant change was a two- or threefold increase in the amount of karyorrhexis, almost entirely restricted to small lymphocytes. The myelocytes showed a questionable decrease in mitoses and increase in karyorrhexis, impossible to interpret with assurance because of the small number of these cells in both specimens.

The second patient (Case 5) with terminal chronic lymphatic leukemia received a total of 240 r during an eight-day period. The white count fell from 61,500 to 49,000 without a change in peripheral blood differential. The spleen decreased in size by 4 cm. No remission was obtained, however, and the patient committed suicide eight months thereafter.

Contrary to the observations in the previous case, the architecture of both specimens was found to be well preserved (Fig. 3, A and B). The posttreatment biopsy, obtained twenty-four hours after the last of the eight treatment days, was similar to the pretreatment biopsy except for minor changes. Nine mitotic figures were found in a single section of the first specimen and none after treatment. The sinusoids in the second biopsy were more widely open, suggesting a decrease in the number of lymphocytes (Fig. 3, B). However, the pretreatment biopsy was too small to serve as an adequate basis of comparison in this respect or as to relative changes in the white and red pulp.

In Case 6, a recently recognized and previously untreated case of chronic lymphatic leukemia, a posttreatment biopsy was done seventeen hours after delivery of 408 r through a 10 × 10-cm. portal over the spleen. The architecture and general histologic appearance were similar to those in a pretreatment specimen (Fig. 4, A and B). The posttreatment biopsy showed a slight but probably significant increase in karyorrhexis of small lymphocytes (Fig. 4, C). Reticular cells were unchanged (Fig. 4, C). There were so few mitoses in the pretreatment biopsy that it was impossible to be sure that there was any decrease in the later specimen. Since the patient had only the one dose of radiation, nothing may be said about the effect on the course of his disease.

Chronic Myelogenous Leukemia: In Case 7, recently diagnosed without prior treatment, an excellent remission was obtained. The spleen, which filled the left and part of the right side of the abdomen prior to treatment, reached 5 cm. below the costal margin after irradiation. The white count fell from 443,000 to 6,500, due primarily to a disappearance of immature cells. Prior to treatment there was present in the spleen an occasional island of white pulp consisting of dense lymphatic tissue. At least 95 per cent of this specimen consisted of red pulp which was so densely and diffusely infiltrated by stem cells and mature and immature granulocytes (eosinophilic and neutrophilic) as to efface the normal architecture and make recognition of cords and sinuses impossible (Fig. 5, A). There was no maturation arrest (Fig. 5, B). Occasional mitoses and a moderate amount of karyorrhexis were seen. This nuclear débris, which was largely unphagocytized and was evenly distributed, was derived primarily from adult granulocytes, not from more immature cells (Fig. 5, B).

The first posttreatment biopsy, obtained sixteen hours after a dose of 424 r, was architecturally similar to the first biopsy (Fig. 5, A *vs.* C). There was, however, a twofold increase in nuclear débris, some of which was phagocytized by reticular cells. Most of this nuclear débris, unlike that in the pretreatment specimen, represented the remains of myelocytes and metamyelocytes and not polymorphonuclear granulocytes (Fig. 5,D and E). The amount of karyorrhexis of adult granulocytes was about equal to that observed previously. There was no evidence of any effect on stem cells or re-

Fig. 5, A–G. Case 7: Previously untreated chronic myelogenous leukemia.

A. Prior to treatment. Diffuse granulocytic infiltrate. ×85.

B. Same biopsy as A. Diffuse granulocytic infiltrate, nuclear débris in polymorphonuclear neutrophils (D), numerous adult granulocytes (G). ×495.

C. Seventeen hours after 424 r. Similar to A. Apparent change due to lighter stain. ×80.

D. Same biopsy as C. Degenerating eosinophil myelocyte (D), intact reticular cells (R). ×495.

E. Same biopsy as C. Degenerating neutrophil myelocyte (D), intact reticular cells (R), polymorphonuclear granulocytes (G), and stem cells (S). ×495.

F. Two weeks after 1,020 r. Decreased cellularity of red pulp (P), acellular white pulp (W). ×80.

G. Higher power through red pulp of F. Myelocytes (M) and stem cells (S) still present but polymorphonuclear granulocytes absent; sinusoids (Z) recognizable due to marked decrease in leukemic infiltrate seen in B. ×495.

Fig. 6, A–F. Case 9: Chronic myelogenous leukemia.

A. Prior to treatment. Diffuse infiltrate of red pulp (R), residual area of white pulp (W). ×85.

B. Higher power through red pulp of A. Diffuse granulocyte infiltrate with maturation arrest; numerous erythroblasts (E). ×495.

C. Higher power through white pulp of A. Dense masses of small lymphocytes. ×495.

D. Karyorrhexis of small lymphocytes (D), in white pulp sixteen hours after x-ray. ×495.

E. Eight days after completion of course of 340 r. More acellular white pulp (W), less infiltrate and more normal architecture of red pulp (R), as compared to A. ×85.

F. Same biopsy as E. Red pulp decreased in cellularity in comparison to red pulp of A; island of megakaryocytes (K). ×85.

Fig. 7, A and B. Case 12: Chronic myelogenous leukemia.

A. Prior to treatment. Dense diffuse infiltrate. ×165.

B. One month after P^{32}. Slight decrease in cellularity, difficult to interpret because of difference in stain. ×165.

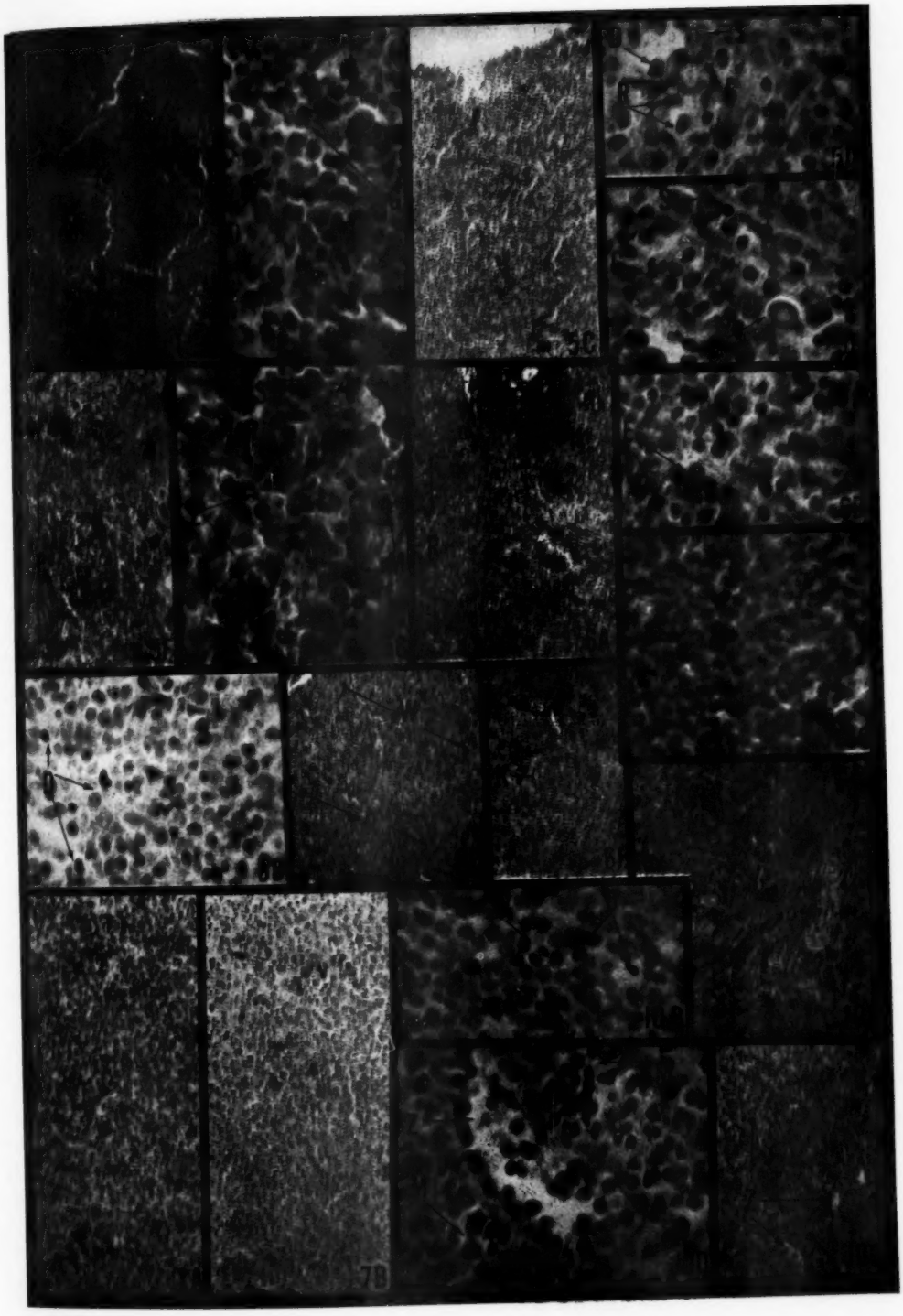
Fig. 10, A–D. Case 19: Acute leukemic transformation of chronic myelogenous leukemia.

A. Acute myelogenous leukemia, prior to ACTH. Dense stem cell infiltrate. ×85.

B. Higher power of A to show karyorrhexis (D) and mitoses (X) in dense infiltrate of stem cells which completely obscure cords and sinusoids. ×495.

C. After ACTH. Reversion toward normal architecture, with recognizable sinusoids (Z), in comparison to A. ×85.

D. Higher power of C. Sinusoids (Z) demonstrable due to decrease in leukemic infiltrate; occasional myelocytes (M) still present. ×495.



ticular cells (Fig. 5, D and E). No mitoses were demonstrable. Unfortunately there was no white pulp in the specimen, so it was impossible to compare the acute effect of irradiation upon leukemic granulocytic and residual normal lymphatic tissue.

A second posttreatment biopsy was obtained five and a half days after the single dose of 424 r. There was no white pulp in this specimen. Karyorrhexis was further increased, involving both myelocytes and adult granulocytes. In other respects, the specimen resembled the two earlier ones. Mitoses were very rare, but present, in contrast to their absence in the biopsy obtained sixteen hours after treatment.

The last biopsy in this case (Fig. 5, F and G) was obtained two weeks after completion of therapy totaling 1,020 r over a period of six weeks, at a time when the patient had attained an excellent remission and the white count was 6,500. Immature cells had disappeared from the peripheral blood. The white pulp, about 3 per cent of the entire specimen, was less cellular as regards lymphocytes than the pretreatment biopsy (Fig. 5, F). In addition to the clearly identifiable white pulp, there were numerous areas composed of whorls of reticular cells, usually enclosing an arteriole. It was impossible to determine whether these areas were white or red pulp denuded of cells by treatment or were trabeculae. The arrangement of reticular cells and the presence of an arteriole argue in favor of their being white pulp in which the normal number of lymphocytes had been decreased by treatment.

The red pulp had changed markedly. The total number of cells of granulocytic lineage had decreased by at least 50 per cent (Fig. 5, F *vs.* A and G *vs.* B). As a result, the red pulp now consisted of areas of fairly normal architecture with clearly recognizable sinusoids and cords (Fig. 5, G *vs.* B), which alternated with other areas in which there was still considerable myeloid tissue. Even in these more abnormal foci myeloid cells were not concentrated enough to obscure completely the red pulp cords and sinusoids. The majority of cells were reticular cells and immature myelocytes. Polymorphonuclear granulocytes were rare (Fig. 5, G). Stem cells were relatively numerous. There was a scattering of polychromatophil and eosinophil erythroblasts. Occasional clumps of basophil erythroblasts were seen, but no organized erythropoietic tissue. This histopathology was in marked contrast to the peripheral blood, from which immature cells had disappeared, leaving only polymorphonuclear granulocytes. This discrepancy demonstrates the unreliability of the peripheral blood as an index of the structure of the hematopoietic tissues.

From a comparison of this last biopsy with the pretreatment biopsy, it was clear that irradiation did not selectively decrease but increased the ratio of immature cells (reticular cells, stem cells, and myelocytes) to adult granulocytes (Figs. 5, B *vs.* G) in the spleen. At this time, however, the immature cells had disappeared from the peripheral blood. The biopsies studied were inadequate to evaluate accurately the relative effect of irradiation upon the residual normal lymphatic as compared to the leukemic granulocytic tissue. There was no evidence of any selective destruction of leukemic tissue.

In Case 8, in a previously untreated elderly female with symptoms of a year duration, there was no response to a course of 722 r of x-ray therapy. The white count fell from 385,000 to 3,500, with disappearance of immature cells and shrinkage of the spleen, but anemia and thrombopenia persisted.

Prior to treatment the appearance of the spleen was essentially the same as in the preceding case except for a scattering of megakaryocytes. It was in these cells that many of the mitoses were seen.

There was no white pulp in the specimen obtained sixteen hours after a dose of 170 r through a 10 × 10-cm. portal, due probably to a sampling error. There were a minute, possibly significant, decrease in

mitoses and an increase in karyorrhexis. This karyorrhexis was in myelocytes.

Another biopsy, obtained twenty-four hours later (forty hours after the single dose of 170 r), showed more degeneration than either of the first two. This specimen included an area of white pulp which was essentially similar to that seen in the pretreatment biopsy, confirming the suspicion that the absence of white pulp in the second biopsy was probably a sampling error. In other respects the third biopsy was similar to the other two.

The next patient (Case 9) had a chronic myelogenous leukemia of malignant course. When first seen, she had a white cell count of 206,000, with 82 per cent neutrophils, and a marked thrombocythemia of 892,000. Treatment with radiophosphorus resulted in an excellent remission lasting six months. Upon relapse, the spleen filled the left side of the abdomen and extended into the pelvis. Hemoglobin was 7.0 gm.; the white count 90,000, with a severe left shift and practically no adult granulocytes. Platelets numbered only 8,000 and reticulocytes 7 per cent. The relapse was therefore not an exacerbation of the chronic myelogenous leukemia but the beginning of a change to an acute myelogenous leukemia.

Prior to treatment, the splenic architecture was obscured by a diffuse granulocytic infiltration (Fig. 6, A). There were, however, many more immature myelocytes and fewer mature granulocytes than would be consistent with the diagnosis of early untreated chronic myelogenous leukemia. An unusual feature was the rather large number, at least for myelogenous leukemia, of erythroblasts scattered through the red pulp (Fig. 6, B). Although the majority were mature eosinophilic erythroblasts, occasional islands of basophilic erythroblasts were seen. This may have been related to the reticulocytosis and the presence of 15 nucleated red cells per 100 white cells in the peripheral blood. Mitoses were found in some of the erythroblasts. Megakaryocytes were rare, perhaps several in the entire biopsy. One small area of white pulp was seen. It consisted of a dense sheet of small lymphocytes and was of itself quite normal (Fig. 6, A and C).

At sixteen hours after 148 r administered through a 10 × 10-cm. portal the architecture of the spleen was unchanged. There was, however, at least a doubling of the number of myelocytes undergoing karyorrhexis, with a similar increase in degenerating small lymphocytes in the residual small areas of white pulp (Fig. 6, D). It was clear that there was no selective effect upon the leukemic granulocytopoietic tissue as opposed to the residual normal lymphatic tissue. There were not enough erythroblasts or megakaryocytes to assay the karyorrhectic effect of irradiation upon these cells. The second effect was a cessation of mitotic proliferation. Actually this was quantitatively minute because of the rarity of mitoses, most of which were in erythroblasts prior to treatment.

The day following the first posttreatment biopsy, x-ray therapy was continued, being carried to a total of 340 r during three consecutive days, through a 20 × 15-cm. portal which included the original 10 × 15-cm. portal. Within eight days following the last treatment the white count fell to 6,800, with 37 per cent neutrophils and 29 per cent stab cells, presenting a marked decrease in the number of immature cells. Platelets remained markedly diminished. There were 2 erythroblasts per 100 white cells. The spleen was now 4 cm. below the umbilicus, whereas prior to treatment it had filled the left abdomen. However, the patient was toxic, she bruised easily, and required numerous transfusions.

At eight days after the completion of the therapy the cellularity of the white and red pulp had decreased by about 50 per cent. The white pulp was now composed of a somewhat acellular network of reticular cells with scattered lymphocytes (Fig. 6, E) as compared to the densely cellular lymphocyte-rich white pulp prior to treatment (Fig. 6, A). The reticular tissue about arterioles was devoid of lymphocytes

TABLE II: RADIOPHOSPHORUS*

Patient	Prior Treatment	Other Treatment	Remission	Comments
10. Br. Mu. Male, 30 yr. Chronic lymphatic leukemia 3 yr.	No treatment first 7 mo. Then local x-irradiation, P^{32}, and ACTH 6 mo. previously	12 transfusions	None; death in 1 mo.	Terminal at time of treatment
11. Ro. Ta. Female, 52 yr. Chronic lymphatic leukemia 30 mo.	Local x-irradiation; massive transfusions, P^{32}; ACTH course completed 1 week earlier†	2 transfusions	None; death in 6 weeks	Terminal at time of treatment
12. Ru. Fr. Female, 58 yr. Chronic myelogenous leukemia 1 yr.	Pills (urethane ?) 4 mo. earlier	2 transfusions	Good	Death 3 yr. later

* Intravenous dose or intravenous equivalent of oral dose.
† See Table IV.

in contrast to the pretreatment stage. The red pulp also had undergone a diminution of cellularity (Fig. 6, E and F *vs.* A) due to a decrease in cells of granulocytic and erythroblastic lineage. Practically all of the cells of the granulocytic series were stem cells and immature myelocytes, so that the ratio of immature to mature cells was greater than prior to treatment. Erythroblasts in the red pulp had increased relative to the myelocytes by a factor of 2 to 3. Unlike the two prior specimens, this one showed organized islands of immature basophilic erythroblasts, an extremely rare finding in myelogenous leukemia. A mitotic figure was seen in about a third or a quarter of these islands. Clumps of megakaryocytes were still present (Fig. 6, F).

In a review of the biopsies in Case 9, it was apparent that there was no selective effect upon immature cells of granulocytic series nor was the leukemic granulocytic tissue more sensitive than the residual normal lymphatic tissue. Also, a severe thrombopenia and anemia persisted in spite of the islands of erythroblastic tissue and of megakaryocytes found in the last specimen.

Six weeks after completion of x-ray therapy severe anorexia, low-grade fever, and weakness developed. The spleen filled the left abdomen to just below the iliac crest. By seven weeks after therapy the white count had risen to 45,000, with 8 myelocytes and 13 metamyelocytes; platelets numbered 25,000. Repeated transfusions failed to maintain the hemoglobin. The spleen now showed an increased number of immature granulocyte precursors with a maturation arrest at the late myelocyte stage so that once again the architecture of the red pulp was obscured and only occasionally was the sinusoidal pattern demonstrable. There was an average degree of karyorrhexis, certainly less than in the specimen obtained sixteen hours after the initial single x-ray treatment. Mitoses were rare. The large number of erythroblasts seen in the prior specimen were gone, although there were from 4 to 80 erythroblasts per 100 white cells in the peripheral blood. Very rarely megakaryocytes were found.

The patient's further downhill course is detailed under steroids.

Radiophosphorus (Table II)

Chronic Lymphatic Leukemia: In Case 10, a terminal stage of chronic lymphatic leukemia, a biopsy was obtained eleven days after the first dose of radiophosphorus, 1.6 mc, and four days after a second dose, 2.0 mc. Within sixteen days after the second dose the white count had fallen from 109,000 to 7,700 and the platelet count remained at 20,000. The spleen had decreased significantly in size. During this time the patient received twelve transfusions, and the hemoglobin rose from 5.0 to 13.0 gm., only to fall to 11.3 gm. within a few days of the last transfusion.

The pretreatment biopsy was unusual in several respects. The architecture was well preserved, so that the cords and sinusoids of the red pulp were easily recognized. Scattered myelocytes, erythroblasts, and even an occasional megakaryocytoblast were present. There was no recognizable white pulp.

Four days after the second dose of P^{32} the splenic cords and sinusoids were less easily recognizable, due to an increase in lymphocytic infiltrate. This reaction is most unusual, the opposite of what had occurred in prior patients. The scattered myelocytes and erythroblasts were no longer found. Mitotic proliferation had ceased. Contrary to observations on the pretreatment specimen, several areas of white pulp were seen, suggesting the possibility that the splenic framework had collapsed on itself so that the areas of white pulp were closer to each other. This change, however, may have been due to a variation in sampling. Unfortunately, it was impossible to obtain another biopsy at the time of maximum decrease in splenomegaly and of white count.

A second patient (Case 11) with terminal chronic lymphatic leukemia had just finished a course of ACTH without any improvement (Table IV). She received 2 mc of P^{32} on three occasions six days apart without any discernible benefit and died within six weeks. Prior to irradiation the spleen biopsy contained two kinds of tissue, dense lymphatic tissue and a large fibrous area.

The specimen obtained the day of the last injection of P^{32} consisted of dense lymphatic tissue without any fibrous scar. This change was almost certainly due to sampling. The cellularity of the two specimens could not be compared, because the first had no white pulp and the second had several nodules of white pulp. The only discernible change was a minute increase in degeneration of small lymphocytes.

After allowance for postmortem change has been made there was no significant difference between the spleen at autopsy, six weeks after the last dose of P^{32}, and the two biopsies. Not even one mitotic figure was seen in the entire section of the spleen.

Chronic Myelogenous Leukemia: Case 12 was that of a woman with a history of chronic myelogenous leukemia for one year. She had been treated intermittently with a drug, the last dose about four months before this study. Immediately prior to treatment with P^{32} she had experienced an exacerbation. Her spleen extended 15 cm. below the costal margin and the white count was 133,000, with many immature cells. Within one month of a single injection of 3 mc of P^{32} the spleen shrank to within 7 cm. of the rib margin and the white count fell to 69,000.

Prior to treatment the spleen presented the usual dense, diffuse hypercellular appearance of chronic myelogenous leukemia (Fig. 7, A). An unusual feature was the presence of an occasional megakaryocyte and scattered erythroblasts in the sinusoids. Two or three clumps of basophilic erythroblasts were seen in each section. Mitoses and degenerating cells were rare. Another unusual feature was that the area about the larger arterioles, normally the site of white pulp filled with lymphatic tissue and in this disease the site of granulocytes and precursors, was composed of dilated sinusoids filled with red cells. The cords separating these sinusoids were composed of reticular cells without any free myeloid or lymphatic cells.

A spleen biopsy obtained four days after injection of the P^{32}, at a time when there was no change in status, was similar to the pretreatment specimen. The only change noted was the absence of the rare islands of basophilic erythroblasts. However, there were so few of these islands prior to treatment that any decrease in number, or even absence, could be due to a variation in sampling.

One month after the first dose of 3 mc the patient was given another 1 mc. The spleen did not shrink any more, but the white count fell to 32,000, due largely to a disappearance of immature cells. Except for a slight decrease in cellularity, the tissue was similar to the other two biopsies (Fig. 7, B *vs.* A).

Urethane

Case 13 was one of previously untreated chronic myelogenous leukemia with symptoms of one month duration. A huge spleen filled the entire left and part of the right side of the abdomen. The white count was 245,000 and the platelet count 300,000. Prior to treatment the spleen showed the usual replacement of its normal architecture by a dense sheet of granulocytes and precursors. There was an exceptionally large amount of nuclear débris, far more than in any other untreated patient and exceeding the amount seen in most patients after treatment. However, as in other cases of chronic myelogenous leukemia prior to treatment, most of this débris represented degenerating granulocytes. Mitoses were average in number for this disease.

Urethane, 4 gm. daily, was given for seventeen days. Thereafter the dose was gradually reduced to 1 gm. over the next thirty days, at which time treatment was stopped. The spleen gradually decreased in size until, when treatment was discontinued, it reached only to the umbilicus. The white cells fell to 12,000, with a fairly normal differential count, and the platelets decreased slightly. The remission was not entirely satisfactory, however, since one transfusion weekly was required to maintain a hemoglobin near 8.0 gm.

Four days after initiation of urethane treatment, although there was still only a minor reduction in size of the spleen and none in the white count, significant splenic changes were noted. The total cellularity was reduced about 25 per cent, due primarily to a decrease in myelocytes and granulocytes. The sinusoidal pattern of red pulp was now barely recognizable. Stem cells had not decreased in number. Their increased prominence was due to the decrease in the mature and immature cells of granulocytic lineage which had obscured everything else prior to treatment. There was an increase in karyorrhexis, primarily of myelocytes and metamyelocytes, without any demonstrable effect on the most immature cells, the stem cells and reticular cells. Mitoses were unchanged in number.

Two weeks after the last dose of urethane the spleen had again enlarged to fill the left side of the abdomen and the white count had risen to 40,000. The spleen was again biopsied. No white pulp was seen even though an unusually large specimen was obtained. The spleen had become much more cellular, although not quite as densely and diffusely hypercellular as before treatment. The increased cellularity was due almost exclusively to the presence of sheet-like masses of stem cells and very immature myelocytes. Many of the stem cells had poorly demarcated cytoplasm and the nucleoli were rather small, resembling the transitional forms between mesenchymal cells and stem cells so common in embryonic hematopoiesis (9, 10, 11), suggesting a surge of heteroplastic neoformation of stem cells from reticular cells. Near the trabeculae occasional areas of still fairly normal red pulp, representing less than 10 per cent of the specimen, were found.

Granulocytes were numerous. However, there was a *hiatus leucemicus* in that the metamyelocytes, which should form a link between adult granulocytes and the immature cells, were grossly deficient in number. Iron was increased in amount and had changed its cytologic appearance. In the first biopsy it was seen in the form of 1-micron amorphous, blue to green granules. Now the iron particles were usually crystalline, larger, and more yellow. Karyorrhexis was unusually frequent, a biologic peculiarity of this particular patient. As in the other posttreatment biopsy, it occurred primarily in more immature cells but not in reticular cells. Mitoses had not changed in number.

The further changes in the patient's clinical status and splenic histopathology will be detailed in the section on combined therapy.

Nitrogen Mustard (Table III)

Hodgkin's Disease: A 44-year-old farm worker (Case 14) had a recently diagnosed. previously untreated Hodgkin's disease.

TABLE III: NITROGEN MUSTARD

	Patient	Prior Treatment	Other Treatment	Remission	Comments
14.	Ji. En. Male, 44 yr. Hodgkin's 4 to 8 wk.	None	None	Good, 11 mo.	Alive and well 2½ yr. later
15.	Jo. Ma. Male, 32 yr. Hodgkin's 2 yr.	None	None	Good, 1 yr.	Death in 3 yr.
16.	Ve. Ro. Female, 37 yr. Hodgkin's 3 yr.	X-irradiation, HN2 twice, last treatment 4 mo. previously	None	Fair, 3 mo.	Severe 2° hemolytic anemia. Death in 1 yr.
17.	Be. Si. Female, 27 yr. Hodgkin's 5 yr.	4 courses of x-irradiation last 10 mo.	None	Good, 3 mo.	Death in 2 yr.
18.	Be. To. Female, 42 yr. Lymphosarcoma 3 to 6 mo.	None	None	Fair, 3 mo.	2° hypersplenism; death in 1 yr.

Following a single injection of nitrogen mustard, 0.4 mg./kg., he had an excellent remission of eleven months duration. All abnormal masses disappeared and the white count fell from 18,000 to 12,000.

Prior to treatment the spleen contained a great deal of hyalinized fibrous tissue resembling amyloid, a finding alleged to occur only after repeated courses of HN2 over many years. (This latter statement, however, was based upon the study of splenic tissue at autopsy without any proof that the amyloid was not present at the start of the disease (12).) Twenty per cent of the spleen consisted of white pulp enclosing secondary nodules with a moderate amount of nuclear débris (Fig. 8, A). One or 2 immature Sternberg-Reed cells were seen at the edge of each area of white pulp. The remainder of the specimen was fairly normal red pulp without any unusual features. There was an average of 2 mitoses for each section made from the biopsy.

A specimen obtained seventeen hours after injection of HN_2 was, except for minute differences, very similar to the pretreatment biopsy. There was an increase in nuclear débris, particularly marked in the secondary nodules (Fig. 8, B). Most of this débris was not phagocytized. The chromatin particles in the Sternberg-Reed and reticular cells were less distinct, giving the nuclei a more empty, swollen appearance (Fig. 8, B). Occasional degenerating Sternberg-Reed cells were seen. No mitoses were found, but there were so few prior to treatment that it was difficult to be sure that their absence after treatment represented a significant change.

Case 15 had an atypical course manifested by an asymptomatic remittent lymphadenopathy for two to three years. Three node biopsies had failed to clarify the diagnosis, sarcoid and Hodgkin's being considered the best possibilities. The node biopsies and the pretreatment splenic biopsies showed large nodular areas consisting of sheets of swollen reticular cells arranged in a pattern suggestive of epithelioid cells of a tubercle and partially surrounded by dense irregular sheets of small lymphocytes. Occasional atypical Sternberg-Reed cells were found. The splenic red pulp was normal. Mitoses were present in the "epithelioid cells" and atypical giant cells. There were scattered karoyrrhectic nuclei.

The patient was treated with two consecutive daily doses of 0.2 mg./kg. of nitrogen mustard, primarily for cosmetic reasons. This was followed by a fall in white count and disappearance of lymphadenopathy and splenomegaly. A biopsy obtained thirty-six hours after the second dose was similar to the pretreatment biopsy except for the absence of mitoses.

Case 16 also illustrates the difficulty of obtaining comparable material in two successive biopsies. The pretreatment specimen consisted of densely fibrous tissue which was badly distorted by the biopsy needle. The specimen obtained four days after the last of two daily doses of 0.2 mg./kg. of nitrogen mustard showed areas of

TABLE IV: STEROID THERAPY

Patient	Prior Treatment	Other Treatment	Remission	Comments
3. Al. Wa. Female, 67 yr. Lymphosarcoma 17 yr.	360 r to spleen completed 2 wk. previously	None	None	Death in 1 mo.
9. Ma. Ro. Female, 27 yr. Chronic myelogenous leukemia	No response to x-ray therapy 12 wk. earlier	Repeated transfusions	None	Severe 2° hemolytic anemia and thrombopenia. Death in $2^1/_2$ weeks
11. Ro. Ta. Female, 52 yr. Chronic lymphatic leukemia 30 mo.	X-irradiation to nodes, massive transfusions, P^{32}, 4 mo. previously	10 transfusions	None	Terminal at time of treatment
19. Lv. Da. Female, 40 yr. Chronic myelogenous leukemia 3 yr.	X-irradiation $2^1/_2$ and $1^1/_2$ yr. ago; control by intermittent P^{32} with last dose 5 mo. previously	24 transfusions	Excellent for 10 weeks; then exacerbation of acute myelogenous leukemia refractory to cortisone and ACTH	Death within 3 mo. after ACTH-induced remission

fairly normal architecture with several nodular masses of white pulp. If evaluation of the effect of treatment had been based only on smears, one would have concluded that lymphocytes were grossly increased after HN2 treatment. However, study of the sections demonstrated that the two biopsies were from areas of the spleen that were not comparable. The second biopsy also contained an amyloid-like material which was not recognizable on the smears.

The next patient (Case 17) had received x-ray therapy during the five years that she had Hodgkin's disease. She was given 0.1 mg./kg. in four daily consecutive doses, resulting in a good remission of three months duration. The pretreatment biopsy showed a large area of fibrous tissue. The remainder of the biopsy consisted of red pulp with scattered Sternberg-Reed cells. Mitoses were seen in reticular cells and Sternberg-Reed cells.

The posttreatment biopsy, obtained seventeen hours after the third of four daily consecutive injections of 0.1 mg./kg. also contained an extensive amount of scar tissue which did not differ from that seen in the first biopsy. The remainder of the specimen consisted of fairly normal red pulp without Sternberg-Reed cells. The absence of these cells and of mitoses as opposed to their presence prior to treatment could as logically be ascribed to sampling red pulp involved in the Hodgkin's process in the first biopsy and normal red pulp in the second biopsy as to the effect of treatment.

Another biopsy, obtained five months later, consisted of fibrous tissue which was quite similar to the prior biopsies.

Lymphosarcoma: In Case 18, a recently diagnosed, untreated lymphosarcoma, there was a fair remission of three months duration following HN2 treatment. Splenic tissue obtained one month after treatment, at a time when there was a significant reduction in size of nodes and spleen, but after recovery from neutropenia, was essentially similar to the pretreatment biopsy.

Steroids (Table IV)

Lymphosarcoma: Case 3, originally treated with x-rays, responded to 100 mg. daily of prednisone with lysis of fever, healing of oral ulcers, and return of appetite. The spleen became softer and slightly smaller, but the white count and platelet count were unchanged. Prior to treatment the splenic architecture was so obscured by a dense sheet of medium lymphocytes that the white pulp could hardly be differentiated from the red (Fig. 9, A). At the end of the twelve-day course of prednisone, the lymphocytic infiltrate had de-

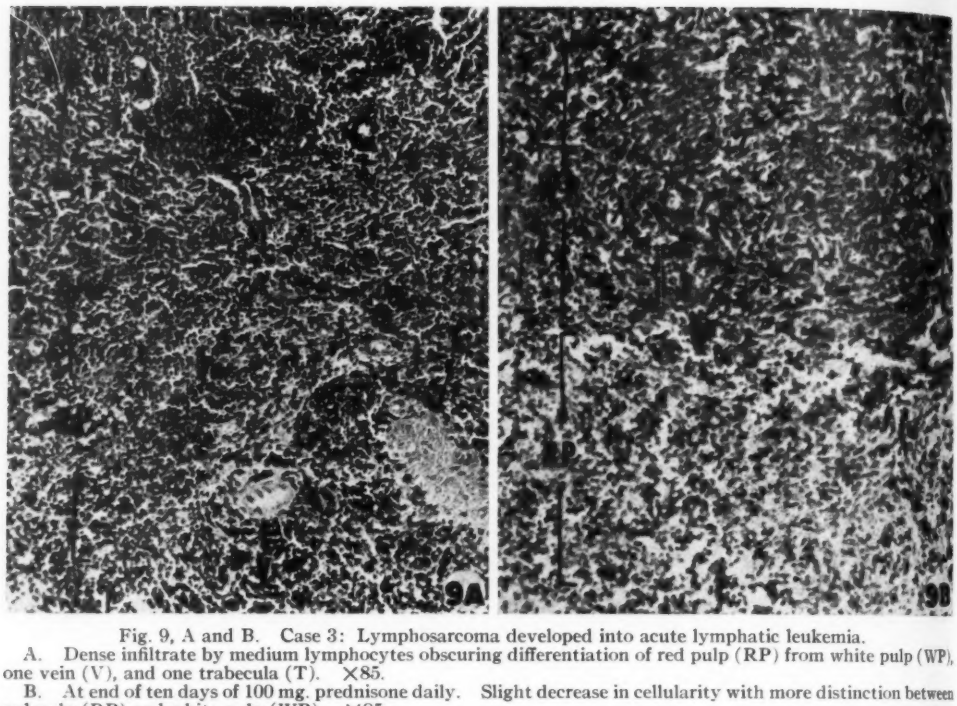


Fig. 9, A and B. Case 3: Lymphosarcoma developed into acute lymphatic leukemia.
A. Dense infiltrate by medium lymphocytes obscuring differentiation of red pulp (RP) from white pulp (WP), one vein (V), and one trabecula (T). ×85.
B. At end of ten days of 100 mg. prednisone daily. Slight decrease in cellularity with more distinction between red pulp (RP) and white pulp (WP). ×85.

creased so that white and red pulp were more clearly differentiated (Fig. 9, A *vs.* B).

Lymphatic Leukemia: Case 11 had become refractory to x-irradiation and to P^{32}. During the twenty-five days of this study the patient received ten transfusions which sufficed to keep her hemoglobin at 7 to 9 gm. Prior to treatment her spleen was almost solidly cellular. White pulp could be recognized, however, making up 15 per cent of the biopsy. The architecture of the red pulp was obscured by a diffuse lymphocytosis. No mitoses were seen. Degenerating cells were rare. Subsequent biopsies were obtained upon the sixth, sixteenth, and twenty-ninth days after initiation of ACTH therapy with intramuscular administration of 150 mg. This dose was gradually tapered to stop entirely on the twenty-fifth day. There was no effect upon the patient's downhill course. Nor was there any essential difference between the biopsies or any change in the white count or size of the patient's spleen.

Chronic Myelogenous Leukemia: In Case 19 there developed a malignant acute leukemic degeneration with subjective symptoms suggestive of a severe influenza. The patient's spleen rapidly enlarged to the iliac crest and her marrow and peripheral blood were composed almost exclusively of stem cells. She became anemic and severely thrombopenic.

An initial spleen biopsy had been obtained eighteen months prior to steroid therapy, when there had been an exacerbation of the chronic myelogenous leukemia. The histopathology was that already described for chronic myelogenous leukemia except for a more marked shift to the left than is usually seen.

At the time of acute leukemic transformation and prior to initiation of ACTH therapy, another spleen biopsy was obtained. The spleen was now composed of sheets of stem cells of so dense an arrangement as to obscure the splenic architecture (Fig. 10, A). Mitoses and degenerating cells were abnormally frequent, particu-

larly in the densest nodules of stem cells (Fig. 10, B). There was no maturation past the stem cell except for occasional very immature neutrophil and eosinophil myelocytes.

Seven days after the second spleen biopsy, treatment with 200 mg. of ACTH daily was begun, the dose being gradually lowered to stop on the twentieth day. The patient had attained an excellent remission of ten weeks duration. The spleen became much smaller, the white cells fell to normal with a fairly normal differential count, and platelets reappeared. A biopsy obtained on the last day of treatment demonstrated a dramatic change toward normal (Fig. 10, C and D). The dense stem-cell infiltrate had practically disappeared so that the architecture of the red pulp was clearly recognizable (Fig. 10, C *vs.* A and D *vs.* B). Scattered immature granulocyte precursors were still evident, but they were about a fifth as numerous as ordinarily seen in chronic myelogenous leukemia (Fig. 10, D). White pulp was not demonstrable. However, scattered normal small lymphocytes were found in the cords of the red pulp and along arterial capillaries, in marked contrast to the absence of these cells in this locality in the biopsy obtained prior to steroid therapy and eighteen months earlier while the patient still had chronic myelogenous leukemia sensitive to irradiation.

During the three weeks after cessation of ACTH therapy there was an exacerbation of the acute leukemia with return of nausea and fever. The white count rose from 5,400 to 10,000, largely due to an increase in stem cells and promyelocytes; the spleen rapidly enlarged, and the platelet count fell from 295,000 to 148,000. The spleen at this time was composed of sheets of stem cells with practically no normal residual red pulp in the biopsy. However, the specimen was unusually small and it is possible that only a nodule of hyperplastic myeloblastic tissue was sampled.

One month after completion of the first course of ACTH therapy and three days after the last biopsy, another course of ACTH therapy was begun and maintained at 200 mg. daily. In addition the patient was given two or three transfusions a week, maintaining a hemoglobin of 9 to 11 gm. In spite of this therapy, her condition gradually deteriorated over ten weeks until death. On the seventh day of this second course of therapy, when the white count had fallen to 1,200 with 4 per cent blasts, the spleen was biopsied. There was an almost complete replacement of splenic architecture by stem cells. The latter were in two patterns, nodular masses with many mitoses and degenerating cells, and a more diffuse pattern in which some vestige of architecture was demonstrable. The marked replacement of splenic tissue by a rapidly proliferating sheet of stem cells was in marked contrast to the leukopenia of 1,200, once again illustrating the error inherent in predicting the state of the tissues from the peripheral blood.

Eleven days later, on the eighteenth day of the second course of therapy, the white count was still 1,200, but with 20 per cent blasts. The spleen had shrunken slightly. At this time about 60 per cent of the spleen consisted of red pulp with clearly demonstrable cords and sinusoids. However, under oil immersion study fairly large numbers of atypical stem cells could be seen in the cords. The sinusoids were distended by red cells. The rest of the specimen was composed of dense islands of stem cells. It is difficult to understand the decreased leukemic infiltrate in this as compared to the biopsy obtained eleven days earlier. The course of the disease was progressively downhill in spite of the decreased amount of leukemic tissue in the spleen.

By the time of the patient's death in the tenth week of the second course of therapy, the spleen had progressively enlarged, the white count had risen to 76,000, with 97 per cent stem cells, and the platelet count had fallen to thrombopenic levels. The postmortem specimen was composed of a diffuse infiltrate of stem cells without recognizable normal architectural pattern.

Case 9 had failed to respond to x-ray therapy in association with the develop-

TABLE V: COMBINED THERAPY

	Patient	Prior Treatment	Other Treatment	Remission	Comments
20.	Fe. Re. Female. Chronic myelogenous leukemia 3 yr.	Several courses splenic x-irradiation, last 6 mo. ago	None	Good; hemoglobin rose from 8.6 to 13.8 without transfusions	Persistent hemolytic anemia and thrombopenia prior to steroids. Later responded to P^{32}
13.	La. Ro. Male. Chronic myelogenous leukemia 1 mo.	None	1 to 2 transfusions a week	Poor	Death 2 weeks after end of treatment

ment of a secondary hemolytic anemia and a change cytologically in the spleen to a more acute myelogenous leukemia. At eight and a half weeks after the completion of irradiation, cortisone therapy was begun, with 200 mg. daily, because of the severe hemolytic anemia (red cell survival twelve days) and thrombopenia. The patient responded with subjective improvement and disappearance of fever.

Another spleen biopsy was obtained twelve weeks after the termination of x-ray therapy and ten days after initiation of cortisone, while the patient was still afebrile. The white count had risen to 75,000, with 12 blasts, 38 myelocytes, and 20 metamyelocytes, representing in comparison to prior counts a shift to a more acute myelogenous leukemia. Total cellularity had decreased in comparison to the prior specimen so that under cursory low-power study the spleen appeared more normal. However, under higher power it was seen that this decreased cellularity was the result of two factors. First, there was a marked decrease in myelocytes, and especially metamyelocytes, resulting in more of a left shift than in the prior specimen. Second, there was an increase in stem cells but not to a degree to offset the decrease in more mature cells. There was, therefore, little correspondence between the spleen and peripheral blood.

At autopsy, one week after the last biopsy, the tissues presented the appearance of an acute myeloblastic leukemia.

Combined Therapy (Table V)

Cortisone and P^{32}: In Case 20 there were a persistent hemolytic anemia and thrombocytopenia in spite of control of other aspects of the disease by x-ray therapy. The patient was given 2 mc of P^{32} and eight days later started on a two-month course of 100 mg. of cortisone. The white count fell and the spleen became significantly smaller.

Prior to treatment the spleen was somewhat atypical for chronic myelogenous leukemia, showing more left shift and less intense granulocytic metaplasia than are usually found in the early stages of chronic myelogenous leukemia. In some respects it simulated the transformation to an acute leukemia.

A rebiopsy on the last day of cortisone treatment showed a significant decrease in maturation arrest and the amount of granulocytic metaplasia, with a reciprocal increase in fairly normal red pulp. Occasional small islands of small lymphocytes, usually in a periarteriolar location, were found. The small lymphocytes were about half as numerous as they would be in a nonmalignant spleen in the corresponding locality. Rarely megakaryocytes and erythroblasts were also seen. Mitoses and degenerating cells were so rare in both specimens that no change could be evaluated. The decrease in granulocytic metaplasia and increases in right shift with treatment more closely resembled what was found in Case 19 after an ACTH-induced remission than what was found in Case 1 after x-ray therapy.

Urethane and Roentgen Irradiation of the Spleen: Two weeks after the end of urethane treatment a course of splenic x-ray irradiation and urethane was begun in Case 13. On the thirteenth day of com-

bined therapy a biopsy was done. In the interim, the white count had fallen from 45,000 to 9,500 and the spleen, which had filled the left and part of the right abdomen, had receded to the iliac crest. One or two transfusions a week were still needed to maintain 9 to 10 gm. of hemoglobin.

The leukemic metaplasia was grossly reduced, so that under low power the architecture of the red pulp appeared normal. Under oil immersion, however, scattered granulocyte precursors and small clumps of stem cells were seen in the splenic cords and an abnormally large number of granulocytes in the sinusoids.

In prior biopsies not only had there been no white pulp but the leukemic tissue had infiltrated into the walls of the arterioles and arterial capillaries, replacing the normal extension of tissue with the characteristics of white pulp which ensheaths these vessels. In this biopsy the tissue surrounding these vessels had the whorl-like pattern of white pulp. Scattered small lymphocytes and plasma cells were found. The concentration of these small lymphocytes was about a fourth of that found in this locality in nonmalignant spleens. These areas resembled corresponding areas seen in the embryonic spleens as the originally myeloid spleen first develops lymphatic tissue (9, 10).

Further study was halted because the patient died suddenly ten days after the last biopsy. Postmortem examination was not obtained.

SUMMARY OF EFFECTS OF TREATMENT

The most important finding in each patient was the *preservation of some histologic evidence of the disease regardless of the completeness of remission as determined by subjective or objective grounds*. Put differently, no treatment completely eradicated the disease or restored the spleen to a normal histologic pattern, although steroids most nearly approached this goal.

In general, the changes produced by any single dose of therapy were minute and recognizable only after careful and repeated comparison of the pre- and posttreatment biopsies examined as unknowns. After allowance for intensity of local effect, the changes produced by x-rays, P^{32}, urethane, and HN2 were similar. Combinations of therapy apparently resulted in a summation of effect. The acute changes following cytocidal therapy consisted of karyorrhexis of myelocytes, erythroblasts, and lymphocytes, and cessation of mitoses. With very rare exceptions, these effects were limited to twenty-four or forty-eight hours after a single dose or treatment. There was excellent evidence to indicate that radiation and radiomimetic drugs had no effect on the reticular cells and stem cells or upon dividing cells, contrary to the much quoted laws of Bergonié and Tribondeau (21). Usually the acute and chronic histopathologic changes, except after steroids, were not pronounced and in general were not commensurate with the changes noted clinically in patients undergoing a remission. Even more disconcerting was the fact that usually the same changes were noted regardless of whether or not the patient responded to therapy with a remission. However, increased karyorrhexis and decrease in cellularity were almost always correlated with a decrease in size of the spleen and a fall in white count.

There was no evidence that any single treatment or even course of therapy induced a significant fibrosis. In occasional cases, however, in which biopsies were obtained several months apart, the later specimen showed an increased amount of fibrosis.

Hemosiderosis, if already present, was unaltered except in those patients receiving many transfusions. This is in striking contrast to observations in animals receiving median lethal doses of irradiation or HN2.

DISCUSSION

Requirements for Histopathologic Analysis of Effects of Therapy: Implicit in a study of this type is the necessity of obtaining adequate control material prior to treatment to serve as a basis of comparison for the tissues obtained after treatment. Only

in this way may one exclude changes occurring as part of the natural history of the disease and variations characteristic of the individual patient. On the basis of this criterion, practically all of the older (13, 14) and the newer literature (15, 16) on this complex subject was found to be invalid.

A second prerequisite demonstrated by this study is the use of a histologic technic which will enable one not only to obtain reproducible material, in which the architecture of the spleen and distribution of cells are unchanged in the course of preparation for the microscope, but will also make it possible to recognize when this goal has not been achieved. This study clearly demonstrates that smears of aspirated splenic tissue fail to satisfy these requirements. Consequently the otherwise excellent studies of Moeschlin (5) and Émile-Weil (17) appear to be invalid.

One other facet that should hardly require reaffirmation is the need to study the spleen itself—not the marrow or peripheral blood—in order to evaluate the effects of treatment upon the spleen. The results of this investigation have made it clear that, although there is usually some relationship between all the hematopoietic tissues and the peripheral blood, there are fairly frequent exceptions which are impossible to predict with assurance. Similarly, as long as there is any question about the relationship of the transmissible lymphomas and leukemias in animals to the spontaneous disease in man (18), one will have to accept with caution studies on the effects of therapy in mice and other laboratory animals.

Effect of X-irradiation on Normal Hematopoietic Tissues: Starting with Heineke (19) and continuing through the studies of the atomic energy research groups of World War II (20), some basic facts of irradiation pathology have been abundantly affirmed. Certain hematopoietic cells (erythroblasts, myelocytes, megakaryocytes, and small lymphocytes) are very susceptible to irradiation. Others (reticular cells, large lymphocytes or stem cells, plasma cells) are not. Any cell is more sensitive in the hematopoietic organs than in the circulating blood. Cells in mitosis are no more sensitive than other cells. There is no known reason to explain the differences in susceptibility of the various cells.

Contrary to the "laws" of Bergonié and Tribondeau (21) there is no evidence that immature, rapidly dividing cells are most sensitive to irradiation. Reference to the *original* paper of these investigators will demonstrate not only the extremely superficial nature of their work but the fact that their concepts were based upon study of *testicular* tissue, not hematopoietic tissue. For completely obscure reasons, the opinions of these authors have gained authority and recognition far beyond their true merit. More recent work upon the hematopoietic tissues demonstrates that rapidly dividing and immature cells are comparatively insensitive to irradiation (22). Certainly the reticular cell, the most immature cell in the hematopoietic tissues, is the least sensitive to irradiation.

As the dose of irradiation decreases, the evidence of radiation effect also decreases, until at about an 1/8 to 1/10 of a median lethal dose (about 80 r in the rabbit) irradiation effects are no longer perceptible by histopathologic technics. However, Hennessy and Huff (23) have demonstrated decreased erythropoiesis in rats receiving as low as 5 r of total body irradiation.

Following a single dose of total body x-irradiation, a highly predictable, if not clearly understood, series of events ensue (20). Within eight to sixteen hours a maximum karyorrhexis is found. There is no further cytocidal effect. The nuclear débris is rapidly phagocytized and cleared within forty-eight hours. An atrophic period, lasting from hours with low doses to as long as ten to thirteen days after a median lethal dose, follows. Thereafter there is a rapid regeneration, which in many respects resembles the first populating of the hematopoietic tissues in fetal life (9, 10, 11), with a regeneration from immature cells (reticular cells and stem cells).

Effect of X-irradiation Upon Malignant Hematopoietic Tissues: There is an almost complete lack of papers based upon an adequately controlled approach to this problem according to the criteria outlined in this study. Prym (13) and, Lubarsch and Wätjen in 1927 (14) and Block in 1948 (15) and 1953 (16) found only six papers based upon adequately controlled studies (8, 19, 24, 25, 26, 27). In only one of these (8) was splenic tissue studied.

The acute cytotoxic effects of irradiation were directed against small lymphocytes and myelocytes, sparing stem cells, the larger lymphocytes, and reticular cells, as has been described in this study. Most of the karyorrhexis was found in twenty-four hours and débris was usually cleared in forty-eight hours. Heineke (19) emphasized the fact that the cells sensitive to x-irradiation in normal tissues were also sensitive in malignant lesions. This study not only reaffirms that concept but also supports the concept that the residual normal cells are just as sensitive as the cells participating in the malignant process. In other words, sensitivity of a cell is not enhanced by virtue of its being malignant nor decreased by its not being malignant. There is no evidence to support the commonly held belief that malignant cells are more sensitive to x-irradiation than the corresponding nonmalignant cells. The shrinkage of the spleen in chronic myelogenous leukemia and the marked drop in the number of granulocytes and precursors in the peripheral blood are not valid evidence for the greater sensitivity of leukemic granulocytic tissue over nonleukemic lymphocytes; in fact, biopsy of the spleen reveals a similar sensitivity.

As in the normal animal, there is no evidence to support the laws of Bergonié and Tribondeau (21). The cells of Case 3 (lymphoblasts, medium lymphocytes), a subacute lymphatic leukemia, were no more sensitive than those in any other case. Mitoses are extremely rare in the lymphocytes of chronic lymphatic leukemia and in the myelocytes of chronic myelogenous leukemia but common in the stem cells of acute leukemia. There was no corresponding alteration in the sensitivity of the cells.

One surprising phenomenon was the comparatively slight amount of karyorrhexis seen after single depth doses of over 400 r. In the experimental animal 400 r given as total-body x-irradiation produces several times the necrotizing effect of a similar dose of x-irradiation restricted to the spleen. One possible explanation is that total-body irradiation exerts not only a direct effect but also an indirect necrotizing effect (20). This, however, is still purely conjecture.

Prolonged repeated x-irradiation will gradually deplete the spleen of most of its free cells, so accounting for a shrinkage of the organ and to some extent for a drop in white count. It is impossible, however, to determine whether a remission will develop since a decrease in leukemic infiltrate occurred regardless of whether or not the patient improved. However, with one exception there was a good correlation between a decrease in cellularity of the spleen and a decrease in splenic size and drop in the white count. It is therefore clear that destruction and/or reduction of the amount of leukemic tissue in the spleen is not the only factor in induction of a remission.

In lymphatic leukemia and Hodgkin's disease no explanation was obtained for the onset of refractoriness to x-irradiation. The refractoriness of Case 3 was probably related to a replacement of small lymphocytes by medium lymphocytes (lymphoblasts). In spite of a poor response, the cytocidal effect of irradiation was as great as in a treatment-sensitive case.

Effect of Radiophosphorus: Experimental work on animals has indicated the essential similarity of all types of ionizing radiation (20). Consequently one would not expect to find any difference between roentgen therapy and isotopic therapy except that due to the dosage, duration, and localization of the irradiation. Animal studies with isotopes (20, 28) have shown that it is possible, under the influence of low-grade but prolonged dosage, to deplete

completely a hematopoietic organ without any demonstrable increase in karyorrhexis or decrease in mitotic activity. This negative observation by no means precludes the presence of such an effect but illustrates the difficulty of recognition of minute changes even with abundant control material, as well as the fact that summation of these minute changes can lead to complete atrophy of an organ. In a prior study of the histopathologic effects of As^{76} (16) mention was made of the comparatively minute amount of karyorrhexis and decrease of infiltrate in contrast to the marked clinical and hematologic changes noted. An explanation was that the radioarsenic in the doses used was equivalent to 50 to 125 r total-body irradiation, a level at which one is barely able to detect karyorrhexis.

In this study 2 terminal cases of chronic lymphatic leukemia were treated with P^{32} with minor and probably insignificant tissue changes. A case of chronic myelogenous leukemia with an excellent response also failed to show any significant change except a slight depletion of leukemic infiltrate. However, as with As^{76}, the intensity of dosage of P^{32} at any one time is quite low. Consequently, it is not surprising that evidence of karyorrhexis and inhibition of mitoses is not demonstrable even though a minor degree of atrophy and a good remission result. As following x-irradiation, similar tissue changes were noted whether or not the patient went into remission.

Nitrogen Mustard: HN2 has been described as a radiomimetic drug. As far as histopathology is concerned, at equivalent doses the effects produced in tissues of animals exposed to HN2 cannot be distinguished from those following total-body irradiation (15, 29). Prior controlled studies, as well as this investigation on the effects of HN2 upon tissues, have yielded interesting information (15). This eminently radiomimetic drug clearly causes as much degeneration and atrophy of normal tissue as it does of malignant tissue. The changes described following its use were strikingly similar to those occurring after irradiation. The same cells which are sensitive to irradiation are sensitive to HN2 and the same patients insensitive to irradiation are usually insensitive to HN2. Also after HN2 there is never any evidence of a complete return to normal of any previously malignant tissue.

Urethane: Only one case was treated with urethane. The changes were similar to those found after irradiation of the spleen. There are no publications dealing with controlled studies of the histopathologic effect of urethane on splenic tissues.

Steroids: In normal animals (30) steroids induce karyorrhexis of lymphocytes as well as inhibition of mitotic proliferation. Regeneration later occurs heteroplastically from reticular cells, which are insensitive to the destructive action of the steroids, and homoplastically from the remaining undamaged lymphocytes. Myeloid cells are insensitive to these agents. Accordingly, except for lack of effect on myeloid tissue, steroids are in part radiomimetic. Clinically they differ from irradiation and more closely radiomimetic drugs in that they will induce a remission in some patients with acute leukemia, accompanied by a return toward a normal histopathology.

In this study the patients with terminal chronic lymphatic leukemia received no objective benefit, nor was there usually any evidence of effect on the tissues. One patient with terminal chronic myelogenous leukemia experienced no remission in spite of a marked decrease in leukemic infiltrate.

Case 19, with an acute leukemic degeneration of chronic myelogenous leukemia, had spectacularly complete clinical and hematologic remission correlated with a markedly decreased leukemic infiltrate. The biopsies failed to reveal the mechanisms by which the leukemic tissue was caused to decrease. As with other forms of treatment, it was obvious that at no time did the leukemic tissues ever completely disappear.

SUMMARY

Roentgen irradiation, radioisotopes, nitrogen mustard, and urethane induce strikingly similar changes in the spleens of patients with leukemias and lymphomas. Steroids differ from the above agents in their ability to cause reversion of the spleen of patients with acute myelogenous leukemia toward normal structure. The cytotoxic or inhibitory effect of a single dose of any agent is measured in hours, not days. Therapy may cause a lessening of clinical activity correlated with a minor or sometimes major decrease in malignant infiltrate *but it never induces complete return to normal morphology*. The decrease in tissue infiltrate appears to be due to a low-grade but repeated or continued destruction of susceptible cells plus a variable degree of mitotic inhibition. The histopathologic changes vary from minute to moderate and in general are not commensurate with the degree or duration of clinical improvement. Furthermore, the same histopathologic changes are noted regardless of whether or not a remission develops, suggesting that some factor other than decrease in amount of abnormal tissue is operative. However, a decrease in splenic size and fall in white cell count are closely correlated with the presence of cells undergoing karyorrhexis.

This investigation sheds no further light on the sensitivity of cells to irradiation or radiomimetic drugs. Evidence is adduced to controvert several widely held but actually unsupported theories. Sensitivity is clearly not correlated with the degree of maturity or immaturity of the cell, its tendency to mitotic proliferation, or whether or not the cell is part of a leukemic or lymphomatous process.

Prior research in treatment has been directed toward the destruction of the allegedly malignant cells and in general the lowering of the white count has been utilized as a measure of therapeutic success. This approach fails to take into consideration two fundamental aspects of the problem (15, 16, 19, 20, 30, 31). First, the most mature cells are continually being replaced by a maturation and proliferation of more immature cells ultimately derived from reticular cells. Second, the most immature cell, the reticular cell, is the least sensitive to therapy.

In planning future lines of investigation it is suggested that efforts be turned toward the following:

1. The mechanism controlling the differentiation and maturation of hematopoietic cells.
2. The factors involved in the regeneration of malignant tissue after a successful remission.
3. Induction of development of normal tissue instead of solely searching for a means to destroy the cell or cells which are only secondary or tertiary manifestations of the malignant process.

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SUMMARIO IN INTERLINGUA

Effectos Histologic Producite Per Radios X, Phosphoro Radio-Active, Mustarda De Nitrogeno, Urethano, E Steroides In Le Tractamento De Leukemias E Lymphomas

Roentgeno-irradiation, radio-isotopos, mustarda de nitrogeno, e urethano induceva frappantemente simile alterationes in le splen de patientes con leucemias e lymphomas. Le steroides differe ab le agentes mentionate per lor capacitate de causar, in le splen de patientes con acute leucemia myelogene, un reversion al structura normal. Le effecto cytotoxic o inhibitori de un sol dose de ulle del agentes es mesurate in horas, non in dies. Le therapia pote causar un reduction del activitate clinic in correlation con un minor e a vices un major diminution del infiltrato maligne, *sed illo nunquam induce un retorno complete al morphologia normal*. Le diminution del infiltrato histic es apparentemente causate per un destruction a basse grado sed repetite o continue de cellulas susceptibile insimul con un grado variabile de inhibition mitotic. Le alterationes histopathologic varia inter minime e moderate e generalmente non es commensurate con le grado o le duration del melioration clinic. In plus, le mesme alterationes histopathologic es notate, sin reguardo a si o non un remission se disveloppa. Isto suggere que un factor altere que le reduction del quantitate de histos anormal participa in le processo. Tamen, un reduction del dimensiones del splen e un reduction del numeration leucocytic es nettemente correlationate con le presentia de cellulas que suffre caryorrhexis.

Le presente investigation non effectua un illumination additional del sensibilitate de cellulas al effecto de irradiation o de drogas radiomimetic. Es presentate datos que argue contra plure datos de acceptation extense sed de facto disproviste de supporto. Le sensibilitate del cellulas es clarmente sin correlation con le grado de lor maturitate o immaturitate, con lor tendentia a proliferation mitotic, o con lor esser o non-esser un parte de un processo leucemic o lymphomatose.

Recercas therapeutic in le passato visava al destruction del presumitemente maligne cellulas, e—in general—le reduction del numeration leucocytic esseva utilisate como mesura del successo therapeutic. Iste conception neglige duo aspectos fundamental del problema. Primo, le cellulas le plus matur es continuemente reimplaciate per le maturation e proliferation de cellulas minus matur que es ultimemente derivate ab cellulas reticular. Secundo, le cellulas le plus immatur—i.e. le cellulas reticular—es le cellulas le minus sensibile al effectos del therapia.

Visualization of the Coronary Circulation by Occlusion Aortography: A Practical Method[1]

CHARLES T. DOTTER, M.D., and LOUIS H. FRISCHE, M.D.

OUR NATION'S highest death rate gives evidence of the failure of traditional therapeutic methods in arteriosclerotic heart disease. In 1959, the disease will take the lives of over a half-million Americans. The lesion which each year is directly responsible for 400 times as many deaths as poliomyelitis is a localized narrowing confined to the proximal divisions of the left coronary artery. We believe that a direct surgical attack constitutes the most logical approach to this essentially mechanical obstruction to myocardial blood flow. If so, it will be necessary to obtain detailed anatomical information concerning the extent and location of disease in order to select patients for surgery, plan the operative approach, and evaluate the results.

This report describes a technic for coronary angiography which has been found to be safe and reliable in the dog. We believe it is ready for application to the study of the diseased coronary arteries of man. In this procedure, a special double-lumen balloon catheter is used to inject a contrast substance into the proximal aorta during a period of brief but total occlusion of the ascending aorta just above the site of injection. There being no alternative, all of the contrast substance enters the coronary arteries, thereby allowing their radiographic visualization with maximum efficiency.

CORONARY VISUALIZATION: BACKGROUND

As far as we have been able to determine, the first *in vivo* contrast studies of coronary arteries were reported by Peter Rousthöi (1) and, independently, by Reboul and Racine (2). Rousthöi's brief but classic article not only described coronary arteriography but also cardiac ventriculography, thoracic aortography, and aortic valvulography. He successfully employed several technics which were subsequently "discovered" by others, including catheterization of the thoracic aorta *via* peripheral arteries, catheterization of the left ventricle *via* the aorta, direct needle puncture of the thoracic aorta, and direct needle puncture of the left ventricle. Thus, by the end of 1933, these workers and others had established experimental or clinical precedent for virtually all of today's contrast cardiovascular technics, including coronary visualization.

Search of the *Quarterly Cumulative Index Medicus* covering 1933 to mid-1955 discloses nineteen papers (3–21) dealing primarily with visualization of the coronary arteries during life. Eight additional articles (22–28A) in recent journals bring the total number of reports to twenty-nine.[2] Doubt is cast upon the alleged maternal role of clinical necessity by the rough calculation that for each scientific report on coronary visualization in the United States since 1933 there have been a half-million deaths due to arteriosclerotic heart disease!

In his Nov. 30, 1945, report, Stig Radner (4) expressed uncertainty as to whether he had succeeded in his efforts to demonstrate for the first time the coronary arteries in living man. His

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[1] From the Department of Radiology, University of Oregon Medical School, Portland, Ore. Presented at the Forty-third Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 17–22, 1957.

This investigation, conducted in the Minthorn Memorial Laboratory, was aided by grants from the Oregon Heart Association, the U.S. Public Health Service, National Institutes of Health—National Heart Institute Grant #H-3275—and the Mallinckrodt Chemical Works.

[2] In the interest of availability and reliability of references, search of the scientific literature has been confined to journals indexed in the *Quarterly Cumulative Index Medicus*. Although this has caused the exclusion of three or four nonindexed reports referred to by other authors, the articles appear to duplicate material already included in the twenty-nine primary references to coronary visualization which we have cited.

published reproduction—though poor by current standards—provides evidence that he did. Though Radner never claimed priority for this important contribution, Meneses Hoyos and Gomez del Campo in 1946 did make such a claim (5), having used transthoracic needle puncture of the ascending aorta to obtain visualization of the proximal portion of the left coronary artery. These authors, in a subsequent publication, stated, "We were the first to obtain good direct thoracic aortographies and demonstrative arteriographies of the coronary arteries. . . (18)." It is our opinion, however, that Nuvoli's successful attempt at thoracic aortography (29) in 1936 and Radner's application of the technic to the coronary arteries had already served to establish both priorities. Although it is probable that coronary arterial visualization had been accomplished by angiocardiography before the time of Radner's report, the event passed without record in the medical literature.

The credit, if not the priority, for widely applied coronary visualization belongs to Jönsson (6). He used thoracic aortography principally *via* retrograde catheterization of peripheral arteries—a technic described by Rousthöi and applied to man by Radner (31)—to inject liberal doses of concentrated iodine-containing organic media into the ascending aorta and thereby the coronary arteries. Not only did he succeed but he was able to publish many beautiful reproductions (32) showing all of the major coronary arteries. For the most part, the visualizations were incidental to the study of congenital cardiac lesions, such as patent ductus arteriosus and coarctation of the aorta. Working with Jönsson's material, di Guglielmo in 1954 reported that he had observed the opacified coronary arteries of man 153 times in a total of 461 contrast visualizations (21). Published data indicate that successful, though incidental, visualizations in angiocardiography and aortography have probably been numerous enough to bring the total up to over 1,000. Angiocardiography is capable of demonstrating the coronary arteries (8) and veins (33), but the best examples are unimpressive and usually encountered in children with cyanotic congenital heart disease. This notwithstanding, it has recently established the diagnosis in a patient with coronary arteriovenous fistula (34). This is a rare lesion, however, and the associated coronary flow tends to favor coronary visualization; the reduced flow in coronary arteriosclerosis does the opposite. Generally speaking, most coronary visualizations and *all* of the good studies in man have been accomplished by thoracic aortography in one form or another.

Thoracic aortography may be accomplished by several approaches, including retrograde injection of fluids or passage of catheters through peripheral arteries. The coronary arteries have also been opacified by means of direct injection (*via* a needle) into the proximal thoracic aorta and similarly into the left ventricle. All of these approaches are alike in that successful visualization of the coronary vessels is determined by the ability to place a large amount of concentrated radiopaque fluid in the ascending aorta, where some of it can enter the coronaries. In one basic respect, all these methods are seriously deficient: there is little control over the disposition of contrast agent, with the result that during systole most of it is swept up the ascending aorta into the systemic arteries while only a small fraction reaches the coronary vessels. Other important disadvantages, notably the hazards of thoracic aortography for coronary arterial visualization, will be discussed subsequently.

It is the authors' belief that the method of coronary angiography described here possesses important advantages. Including our own approach, however, we know of no technic for coronary visualization which is entirely satisfactory with respect to simplicity, safety, and reliability. Although the method described is not simple, we believe it to be both safe and reliable.

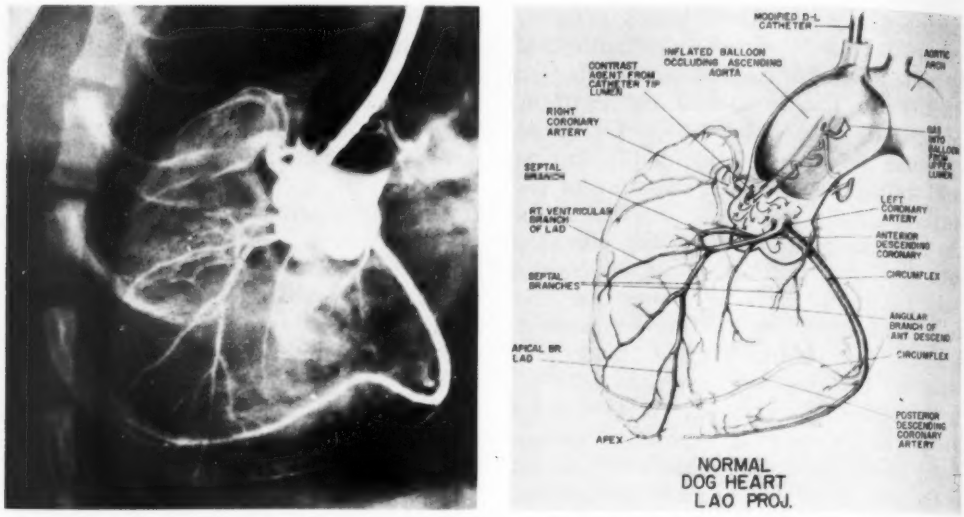


Fig. 1. Selective coronary arteriogram in the normal dog by the technic of occlusion aortography. Left anterior oblique projection at termination of injection of 5 c.c. of contrast agent made during complete occlusion of the ascending aorta peripheral to the site of injection.
The tracing is slightly augmented by reference to an additional but similar film on the same animal.

CORONARY VISUALIZATION: TECHNIC

The double-lumen balloon catheter used in this technic is one of a type first described in 1950 (35). One lumen reaches to the tip of the catheter and a second smaller lumen terminates by a side opening in the catheter wall about 1 inch short of the tip. The latter lumen provides access to a sleeve-like, latex balloon secured to the shaft of the catheter above and below the side orifice. Collapsed, the balloon conforms to the shape and diameter of the catheter; freely distended, it is sausage-shaped and has a diameter exceeding that of the human aorta[3] (Figs. 1 and 2).

A light general anesthetic is preferred. Following a preliminary rinse in heparin and under sterile precautions, the special catheter is introduced into the right radial artery exposed just above the antecubital fossa (the right common carotid in dogs). The injection-lumen is kept patent by intermittent irrigation with heparinized saline. Fluoroscopy is employed to guide the tip of the catheter into the ascending aorta and downward until it reaches a position about an inch above the estimated site of the aortic valves. We have found an image-amplifying fluoroscope, the Philips Surgex, invaluable for this purpose, since it may be used when needed and then promptly moved out of the way, and since its bright image eliminates the hazard (36) of darkening the room or wearing red goggles while operating.

With the tip of the catheter occupying what is believed to be the proper position, trial inflation of the balloon is carried out by the injection of nitrous oxide or carbon dioxide—*never air*—into the lumen leading to the balloon. It is essential that complete occlusion be obtained if the examination is to be successful. Trial occlusion may be repeated several times if necessary, although the duration of each occlusion should not exceed five or ten seconds.

[3] The Type I Dotter-Lukas catheters used in this study were purchased from the U. S. Catheter and Instrument Corporation, Glens Falls, N. Y., Modification was required and consisted of replacing the balloon with one large enough to occlude the human aorta. For larger balloons, aluminum rods were turned to appropriate dimensions and were then dip-cast in latex by the Huntington Rubber Mills, Portland, Ore. (Mr. Philip E. Hodel). The balloons were readily attached to the catheters by fly-tying technics and materials. Ordinary toy balloons provided a colorful alternative but also a problem in securing the necessary concentric relationship to the catheter shaft during inflation

Deflation should always be accomplished gently; forceful withdrawal of the syringe plunger may result in drawing the wall of the balloon into the catheter lumen, creating a defect in the rubber, with release of the gas into the aorta. This is consistent with the life of the patient if not the integrity of the catheter. Complete occlusion may be assumed to be present when the right carotid and left arm pulses are simultaneously obliterated; proof is readily obtained through the trial injection of a small volume of contrast agent and concomitant exposure of a film. Once the correct position of the catheter and volume of gas necessary for complete occlusion have been determined, the examination proper may be carried out.

With all in readiness, the occluding balloon is inflated as rapidly as possible, usually in one or two seconds. As soon as complete occlusion is obtained, the injection of contrast substance is begun with the use of a pressure device, if necessary, to inject the required dose in three seconds or less. Simultaneously with the beginning of the injection, a series of x-ray exposures is started and continued for six to eight seconds. Deflation of the balloon is allowed to take place at the end of the injection, even before filming is complete. If desired, the procedure may be repeated in the same or another projection. At this state of our knowledge, a maximum of three injections is believed to be permissible. At least five to ten minutes should intervene between such injections. For reasons to be discussed, we have come to the conclusion that Thorotrast is the most suitable medium currently available. We use it in doses of 5 c.c. in the average dog and 10 to 15 c.c. in the adult human being. Continuous electrocardiographic monitoring should be conducted during and following all occlusions. Arrhythmias, other than occasional ectopic ventricular beats at the time of inflation, are regarded as a contraindication to further activities. Minor T-wave elevations and inversions following injection are not significant provided there is a prompt return to normal. Such changes occur regularly when organic iodides are used as the contrast medium.

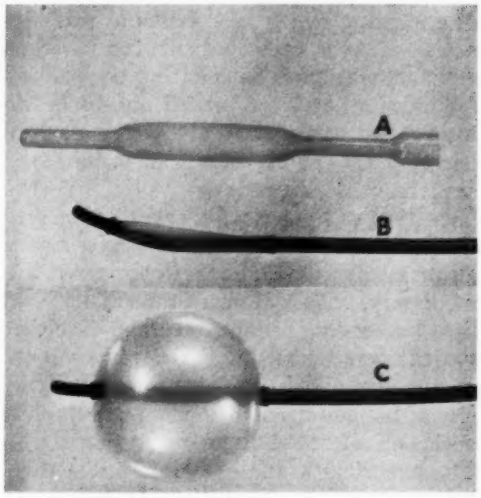


Fig. 2. Distal end of balloon catheter. A. Dipped latex balloon with expanded midsection, designed for human use. B. Assembled catheter with constant cross-sectional balloon for animal use. C. Animal catheter with balloon fully inflated.

The catheter is next withdrawn, the artery repaired, the skin closed, the electrocardiographic leads disconnected, the anesthesia discontinued, and the examination is over.

Experimental and clinical experience with this procedure has shown that myocardial anoxia during attempted occlusion signifies that the occluding balloon has slipped downward so as to occlude the coronary orifices. Careful technic usually prevents this occurrence, while a vigilant watch on the electrocardiogram allows its recognition in ample time to correct matters before harm results. This and another complication of occlusion aortography—inadvertent rupture of the balloon—were observed during the study of two human patients with angina pectoris in April and May 1957. In one patient, nonvisualization resulted when the balloon slipped downward to occupy a position straddling the aortic valve ring. Within seconds, segmental elevation appeared in the electrocardiogram, promptly

disappearing when the balloon was deflated. In the other patient, too vigorous an effort was made in deflating the balloon following what later turned out to be an incomplete occlusion. The latter resulted in very poor visualization, while the overvigorous deflation resulted in the liberation of 35 c.c. of nitrous oxide into the patient's ascending aorta. Here again, electrocardiographic changes appeared immediately, with a return to normal within the succeeding sixty seconds. Neither patient was harmed. Failure in each instance was due to underestimation of the size of balloon needed to produce complete occlusion of the human ascending aorta. The spherical shape of a freely distended balloon is by no means the shape assumed within the aorta. There, it tends to conform to the lumen of the vessel and shows a remarkable ability to send localized pseudopod-like dilatations into the transverse arch and up into the innominate artery.

OCCLUSION AORTOGRAPHY: EXPERIMENTAL STUDIES

Experimental observations were made on a series of 51 dogs in order to determine the feasibility of this procedure. Over 500 complete occlusions of the ascending aorta were produced without death or evidence of serious consequence. In connection with over 350 such occlusions, various substances were injected into the occluded proximal aortic segment. These substances included four radiopaque contrast media, Hypaque, Urokon, Miokon, and Thorotrast, as well as saline, nitrous oxide, carbon dioxide, air, and plastic microspheres (for coronary embolization). Except when air or microspheres were used, no injection *per se* proved lethal. The death of 3 or 4 animals in the series resulted from inept surgical technic or a long series of procedures wherein deliberate overdosage with contrast media had been employed for the express purpose of eliciting toxic reactions.

The principal experimental observations consisted of arterial blood-pressure determinations (over 200 observations in 30 animals) made proximal and distal to the occluding balloon by means of Statham P23A gauges and a Sanborn multichannel recorder; electrocardiographic tracings (272 observations in 36 animals); heart rate, determined on the electrocardiograms; respiratory rate (12 different runs); and radiographic studies (approximately 100 single or serial studies). The findings will be summarized briefly.

Blood Pressure: A continuous record, made at slow paper speed so as to show the typical blood-pressure response to complete aortic occlusion, is presented in Figure 3, while Figure 4 reveals average systolic blood-pressure response curves associated with the injection of various contrast media in identical procedures in 3 dogs during aortic occlusion. As can be seen, the dominant response is that produced by the occlusion itself. More refined studies apparently will be required to detect modifications, if any, due to the injected substances. In general, the sudden onset of complete occlusion of the supracoronary aorta results in a prompt increase of systolic pressure to double the control level. In a series of 12 animals selected to represent the entire group, the average increase in systolic pressure amounted to 78 per cent of the control (maximum rise 130 per cent, minimum rise 50 per cent of control). The maximum systolic pressure observed in the entire series was 336 mm. Hg. A pronounced concomitant increase in pulse pressure was observed in every instance. After a few seconds, the elevated pressures declined slightly tending to stabilize about 60 per cent above the control levels until the occlusion was terminated. With sudden removal of the occlusion, the pressure fell to subnormal levels but returned almost to control levels within a matter of seconds. Recovery was complete within a minute of the beginning of the study if the duration of the occlusion was not greatly prolonged beyond fifteen seconds. In a few animals, complete aortic occlusion was maintained for over a minute and one-

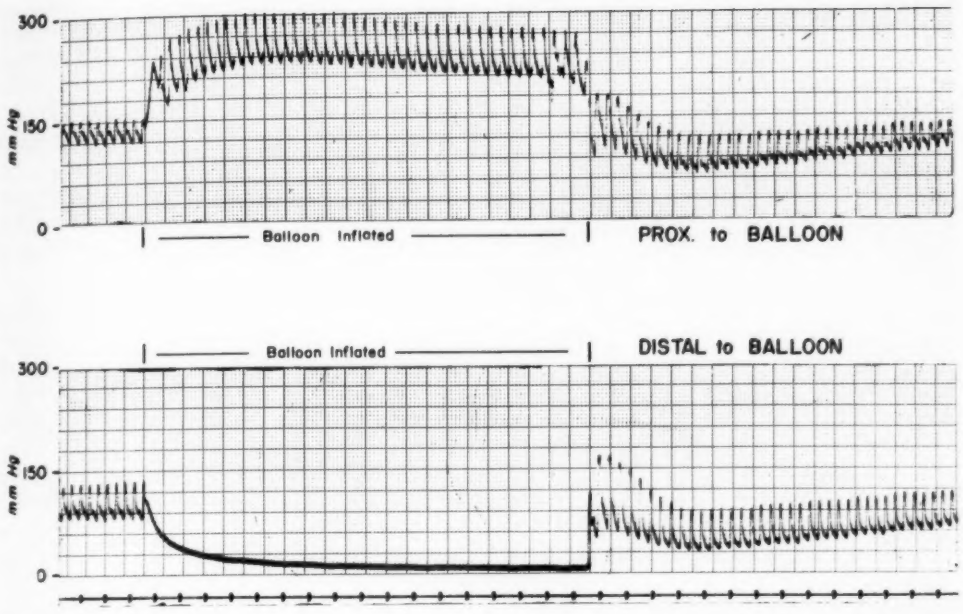


Fig. 3. Blood-pressure response proximal and distal to total occlusion of ascending aorta (Dog No. 9; 15 seconds occlusion).

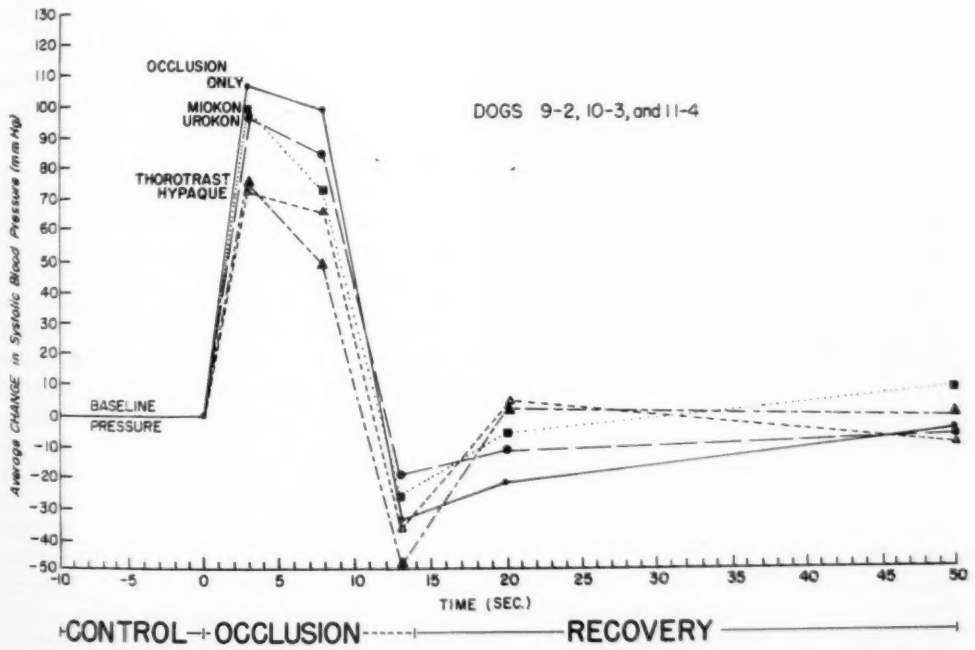
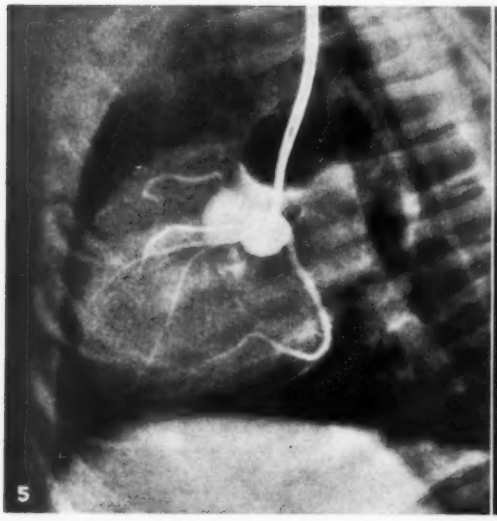


Fig. 4. Blood-pressure changes proximal to occluding balloon as related to injection of various contrast media. Dominant response is due to aortic occlusion.



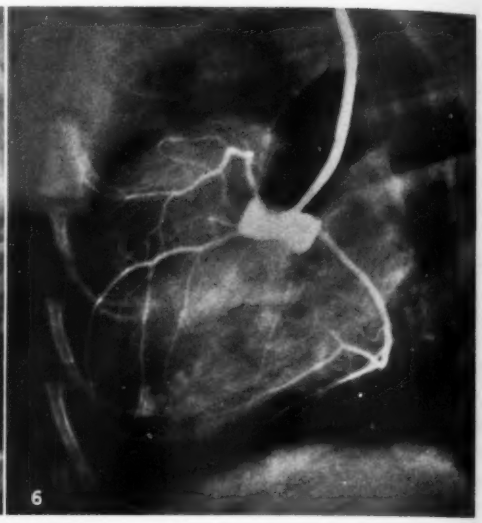


Fig. 5. Coronary arteriogram following injection of 4 c.c. Thorotrast in Dog No. 7.
Fig. 6. Dog No. 13, one second after injection of 8 c.c. Thorotrast. Moderate aortic insufficiency demonstrated.

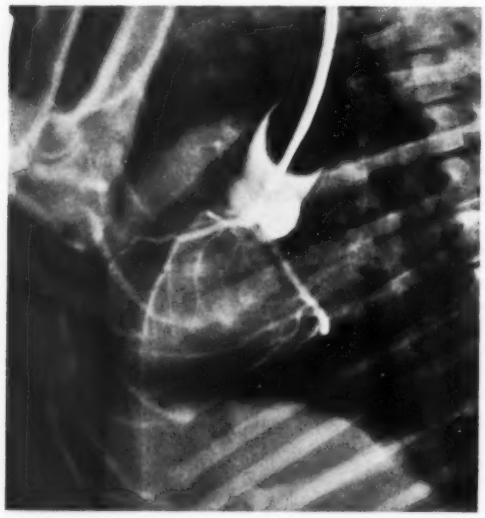


Fig. 7. Dog No. 22. Good visualization with 4 c.c. Thorotrast.

half without producing qualitative change in the reaction. The magnitude of pressure change proximal to the occlusion appeared to vary more or less directly with the level of control blood pressure. Distal to the balloon, pressures fell precipitously with the onset of complete occlusion, reaching a nonpulsatile plateau at between 6 and 30 mm. Hg. The post-occlusion pressure could best be described as a gradually falling mean pressure.

Electrocardiographic Findings: In a consecutive series of 27 dogs, electrocardiographic tracings were simultaneously recorded from leads AVR, AVL, and AVF before, during, and after 236 occlusions, 158 of which were accompanied by the injection of material into the occluded aortic segment. In 14 of these 27 animals, additional chest leads were also recorded. In 9 other dogs, only the AVF lead was used (for x-ray exposure-timing purposes) during 36 occlusions, all with the injection of an opaque medium. These 36 runs showed no apparent differences from the multiple lead tracings which formed the basis for analysis.[4] Sudden, complete aortic occlusion without injection produced no recognizable electrocardiographic change (other than in heart rate) in 22 of the 27 dogs studied. The remaining 5 dogs had occasional ectopic beats, usually limited to the first of repeated occlusions, and believed to be of no consequence.

[4] The authors wish to acknowledge their indebtedness to Hance F. Haney, M.D., Professor of Medicine, University of Oregon Medical School, for his generous and competent assistance in interpreting the electrocardiographic data.

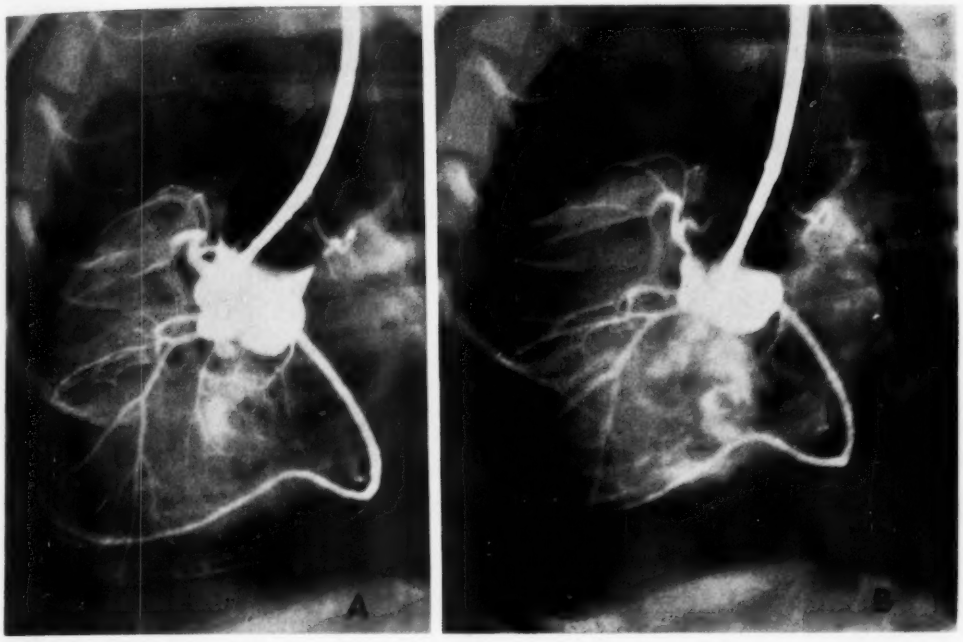


Fig. 8. Serial coronary arteriograms utilizing 4 c.c. Hypaque: A. 0.5 second after injection; B. 1.5 seconds later.

When injection was carried out proximal to complete aortic block (158 observations in the same 27 dogs), definite electrocardiographic changes were the rule, varying with the nature, concentration, and volume of the injected substance. The incidence of ventricular ectopic beats did not appear to be increased by the injected material. Immediately following injections, however, T-wave elevations and inversions appeared in all three leads. These changes varied in magnitude and duration with different injected substances, but were present even with saline. They were most pronounced when iodine-containing media were used. Of the latter, Hypaque—though it produced the least effect of the three iodine-containing media—caused electrocardiographic alterations of considerably greater magnitude than did Thorotrast. The effect of Thorotrast was approximately the same as of saline. While Hypaque always produced definite T-wave elevations and inversions, Thorotrast rarely caused any change other than slight T-wave elevations.

In toxicity studies involving deliberate overdosage with amounts equaling the quantity of agent used for conventional thoracic aortography, an episode of ventricluar tachycardia followed the use of Hypaque, and one dog died of ventricular fibrillation following overdosage with concentrated Urokon. The studies of other workers gave ample reason to anticipate these consequences.

The electrocardiographic changes associated with the intracoronary injection of substances during aortic occlusion provide an extremely sensitive means for the comparison of various agents, including saline. The changes are of particular interest in comparing different contrast media and will be described and discussed in detail in a subsequent report.

Heart-rate studies during the period of occlusion often exhibited an initial period of moderate bradycardia followed by tachycardia during recovery. This is believed to be consistent with reflex responses to aortic sinus stimulation.

Radiographic Studies: Approximately

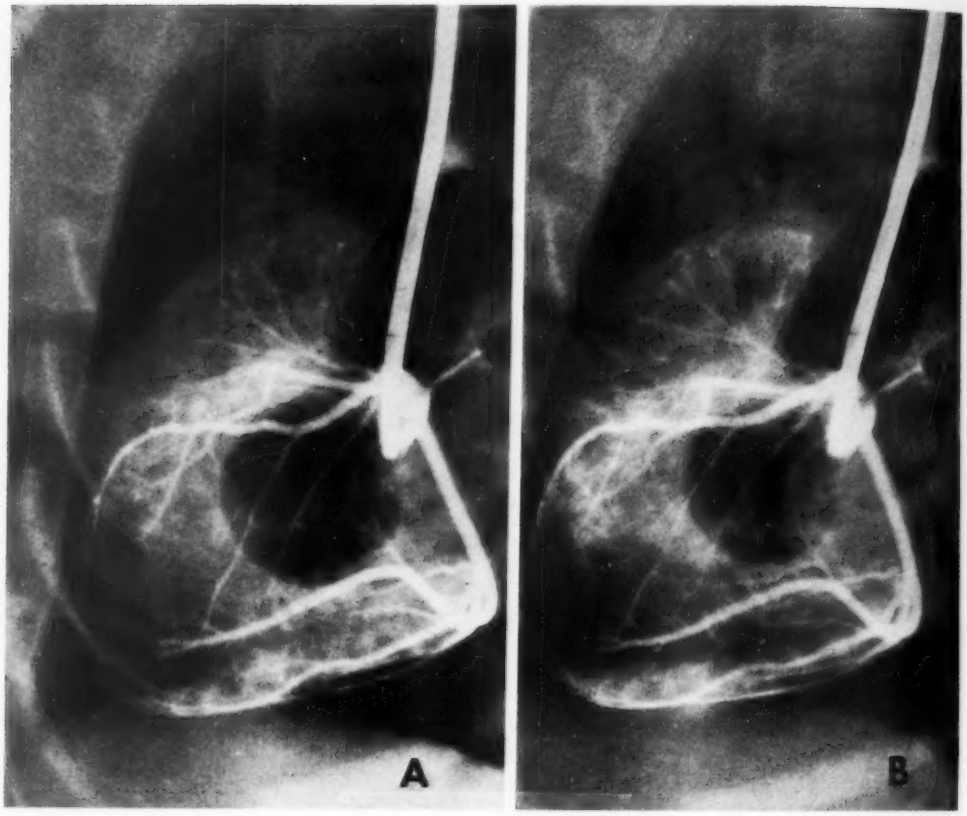


Fig. 9. Balloon too large, with herniation through aortic valve ring. There is dense opacification of left coronary artery; nonvisualization of right coronary.

100 radiographic examinations, about a third of which were serial studies, were conducted in dogs in association with the injection of opaque substances proximal to a balloon occluding the ascending aorta. In the vast majority of instances, excellent visualization of the coronary arteries resulted (Figs. 5 through 8). A few failures resulted when the position of the balloon was allowed to change before injection. In one instance, this led to a desirable by-product of the procedure when injection was carried out unwittingly, and later intentionally, with the balloon in the descending aorta (Fig. 13). Less desirable results were obtained when the balloon was allowed to slip downward into the left ventricle, resulting in filling of only one coronary artery (Fig. 9). Incomplete occlusion and prolonged injections were, in a few instances, the cause of substandard results. To be effective in the presence of augmented coronary flow (see below), the injection must be accomplished within a total time of two seconds. With the doses employed for human coronary arteriography, the use of pressure injection apparatus is probably required.

That this method for coronary visualization is reliable and readily mastered is evidenced by the fact that Figures 5, 6 and 7 are single-exposure studies done entirely by third-year medical students without previous training in cardiovascular radiography. Although adequate visualization of the coronary arterial system can reliably be obtained with but one exposure, serial studies reveal other portions

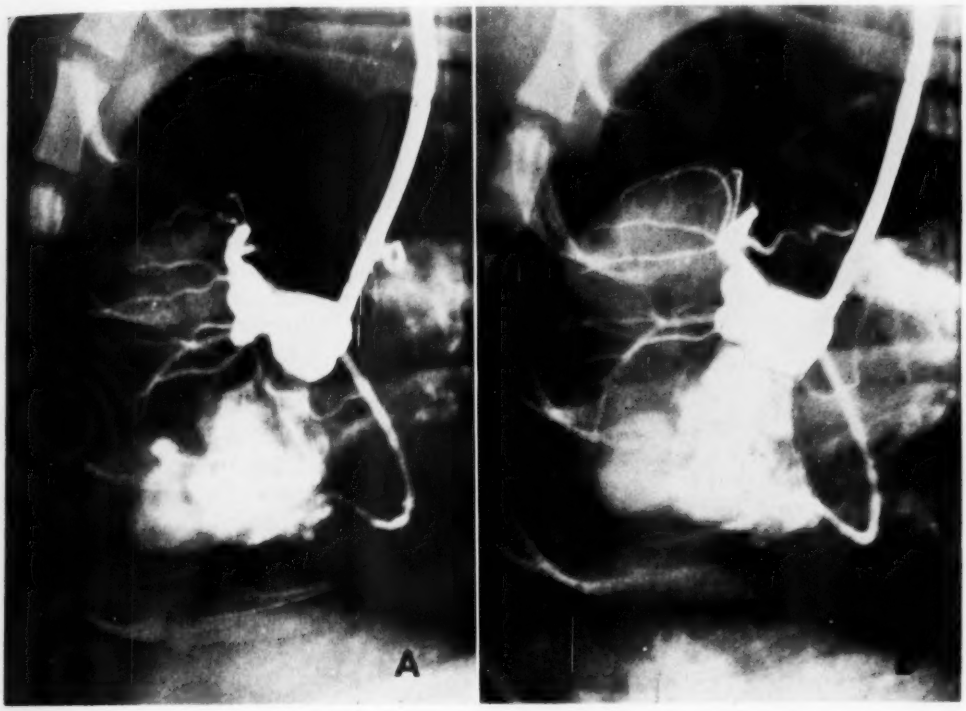


Fig. 10. Dense opacification of both coronary arteries, despite marked aortic insufficiency. Balloon is too large and not concentric with catheter.

of the coronary vascular system and are, therefore, preferable. Serial study lessens the remote possibility of failure due to faulty timing. It should be stressed that poor or inadequate visualization was quite rare and, for the most part, came early in the course of this investigation.

Analysis of the films indicates that the visualization obtained is entirely adequate for outlining coronary arteries for several successive branchings. Its limitation in this direction is related to the ability of the radiographic system to produce detail under the circumstances of study. Opacification of the smallest discernible branches appeared adequate to have taken advantage of finer detail had there been means for achieving it. The use of ultrashort exposures and induced cardiac arrest in the intact animal will expand the usefulness of this and many other contrast cardiovascular procedures. In addition to demonstrating the coronary arterial and venous system, the technic proved capable of showing the diffusely opacified myocardium, analogous to the pulmonary capillary phase of angiocardiography and to that seen in renal and cerebral angiography (Fig. 15). Reflux of medium into the left ventricle was observed repeatedly in the course of this study. Occasionally, this appeared to have resulted in a lower quality of opacification. That it is also consistent with good studies is illustrated by Figure 10. The presence of laminar flow within the circumflex coronary artery was observed when x-ray exposures of one millisecond were employed (Fig. 11).

In summary, our radiographic exploration of occlusion aortography as applied to demonstration of the coronary vessels indicates that it is a highly satisfactory method of achieving visualization of the entire coronary circulation with the injection of a small dose of contrast medium. The reproductions in this article are suffi-

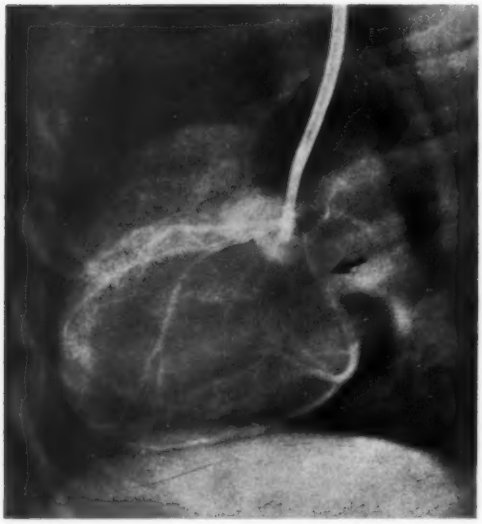


Fig. 11. Laminar flow within coronary arteries, shown in one millisecond exposure, at 98 kv, 800 ma. Film exposed three seconds after injection of 5 c.c. Thorotrast.

ciently representative of the entire series to serve as documentation for this statement.

DISCUSSION

Safety of Occlusion Aortography for Coronary Visualization

There are three major factors which bear upon the safety of the procedure described in this paper: (1) *operative technic* or the hazards of aortic catheterization *per se;* (2) *effects of aortic occlusion,* in relation to physiological consequences; (3) *choice of contrast agent* or the toxicology of coronary visualization.

Operative Technic: The fairly straightforward technical requirements of this procedure are about the same as those of conventional thoracic aortography by catheterization. Nevertheless, should this procedure receive the widespread application we believe it deserves, error and accident during catheterization will provide its most important risk. In his monograph on thoracic aortography, Jönsson (32) said: "Provided the catheterization is done correctly, the taking of thoracic aortograms incurs no risk other than that with the toxicity of the contrast solution." Of the numerous deaths which have since resulted, we know of not one which fails to bear out the truth of that statement. Inasmuch as the contrast agent used for our method is relatively nontoxic compared to the organic iodides, it appears that the slight risk of occlusion aortography will lie in Jönsson's first category. This is supported by experience in the laboratory which has led us to believe that the risk of occlusion aortography can be reduced to a minimum defined by technical competence. Reasons for exonerating other factors follow.

The Effect of Aortic Occlusion: Sudden, complete but brief occlusion of the supracoronary aorta is not a significant hazard of this procedure. Our experimental substantiation is impressive, consisting of the production in dogs of 500 such occlusions, each from two to twenty times the required duration, without harm in any instance. That tolerance of aortic occlusion is physiologically sound is obvious from the fact of its occurrence. It is also readily explained.

Supracoronary aortic occlusion causes an immediate decrease in the pressure and flow of blood beyond the obstruction, as though a faucet were turned off. Instances of survival following cardiac arrest or ventricular fibrillation, as well as countless examples from the cardiovascular surgeon, have shown that complete circulatory arrest for a period of one or two minutes is without danger, particularly when coronary flow is maintained. To think otherwise would, by implication, cast aspersions on the honored sphygmomanometer cuff.

Proximal to the obstruction, there occurs a somewhat more complicated chain of hemodynamic events. Although our pressure records provide detailed evidence in this respect, these data will be the subject of separate reports, the following statement of their net effect serving present purposes. As a result of obstruction of the aorta, coronary flow is increased sufficiently to more than compensate for the left ventricular workload despite the

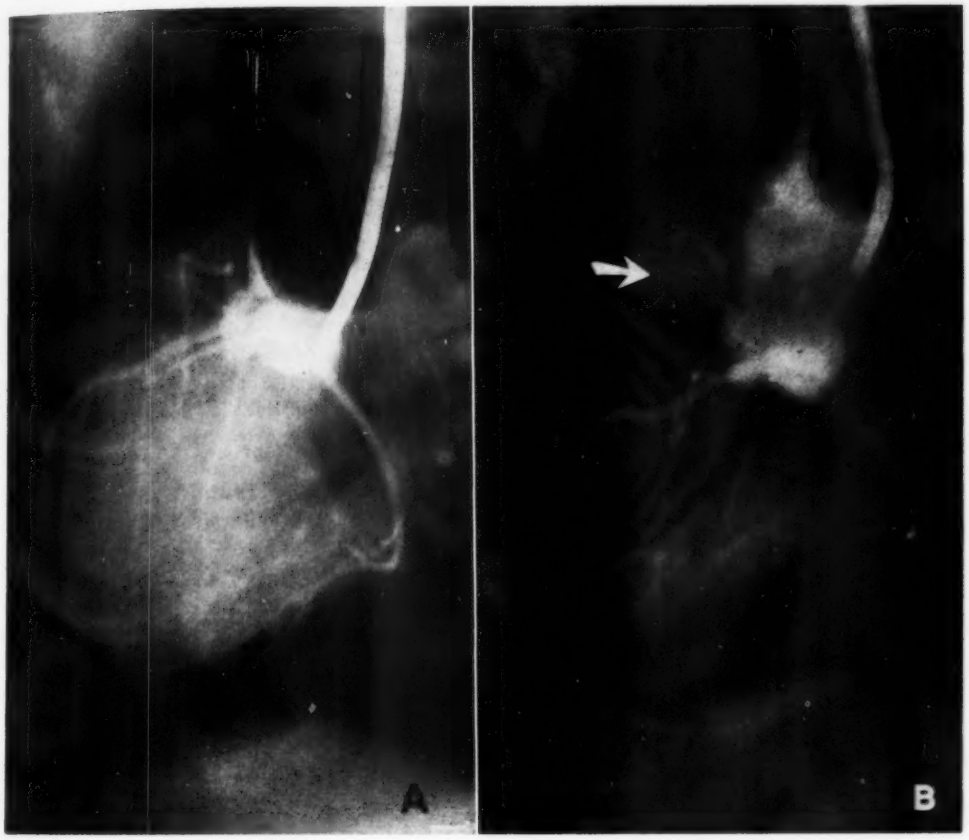


Fig. 12. Coronary arteriography following ligation of right coronary artery.
A. Control arteriogram, prior to surgery.
B. Arteriography performed three days after ligation, showing obstruction approximately 2 cm. distal to origin of right coronary artery.

presence of hemodilution caused by the volume of nonoxygen-bearing contrast agent we use. This being the case, the heart is well able to maintain its function despite the occlusion. The complete absence of left ventricular strain pattern in the 272 electrocardiograms taken during complete aortic occlusions in dogs substantiates this, as do the views of Wiggers (37) and the experimental data of many reputable investigators (38–42). To cite an extreme, ten Cate and Horsten (40) observed, twenty minutes after cross-clamping the ascending aorta, that the exposed heart of the cat continued to beat forcefully. Our procedure requires but five seconds. Further studies are needed to determine the extent to which coronary arteriosclerosis will limit what appears to be a wide margin of safety. To date, our experience with diseased coronary vessels has been confined to ten dogs previously subjected to ligation of various coronary arterial branches (Fig. 12). In these, there was no evidence that harm had resulted from the procedure. From the experiences of others gained during cardiac surgery, it is apparent that coronary flow may be completely but harmlessly interrupted for a minute or more. Thus, it seems reasonable to conclude that indication and contraindication, though antagonistic, are not incompatible.

Questions have been raised concerning

the effects of acute hypertension on the left ventricle and coronary arteries. With respect to ventricular rupture, it would probably be advisable, for the present at least, to regard occlusion aortography as contraindicated during the first month following acute myocardial infarction. Wessler, Zoll and Schlesinger (43) point out that rupture of the heart cannot take place through areas protected by scar or anastomosis following previous myocardial infarction. From this point of view, old myocardial infarction is not a contraindication to the procedure. With respect to the coronary arteries, it is unlikely that damage would result from a ten-second period of hypertension during which blood pressure does not exceed that occurring in the everyday life of modern man.

Choice of Contrast Agent: Perhaps the principal hazard to patients undergoing competent diagnostic x-ray examination is that caused by artificial contrast agents. More than 200 fatalities have resulted from the intravenous use of iodine-containing urographic media (44–49). Abrams (47) collected 29 deaths, representing 1.7 per cent of 1,706 thoracic aortographic examinations, and concluded that, "when a 70 per cent concentration of the medium was employed, the mortality rate was eight times higher than with concentrations of 30 to 35 per cent." It is our belief that the injection of concentrated organic iodide contrast media into the coronary arteries is prohibitively dangerous. The occurrence in our series of two major ventricular arrhythmias in dogs given 10 c.c. of concentrated Hypaque and Miokon supports this belief, as do the electrocardiographic changes accompanying studies at all dosage levels. Mudd *et al.* (49) recently reported significant gross and histologic changes in the lung following unilateral injections of concentrated Urokon into one main branch of the pulmonary artery of dogs. They concluded: "Our results give evidence of direct damage to pulmonary tissue as indicated by pulmonary edema, congestion and thrombosis in both capillaries and larger vessels. This reaction is most severe with higher concentrations of the medium such as occur with injections directly into a pulmonary artery." With respect to concentrated organic iodides and contrast visualization, we are faced with the horns of a diagnostic dilemma: the higher the concentration the better the visualization, but the more dangerous the procedure. The brain's susceptibility to Diodrast was shown years ago (50). We know of no reason to think the heart immune. Inasmuch as the newer urographic media bear a close chemical relationship to their predecessors, it is likely that all three—Hypaque, Renografin, and Miokon—will be found to possess lethal potential when sufficient experience has accumulated to reveal their true toxicity.

With these considerations and our own experimental data in mind, we have chosen Thorotrast as the contrast agent for this technic. Though Thorotrast is repeatedly alleged to possess carcinogenic properties of great importance to man (51–53), the fact remains that, while many injections have been given, yet a causal relationship to human cancer is still to be proved. In the conclusion following his classic study of late clinical changes, Looney (54) states: "No definite conclusions can be drawn concerning the possible relation between Thorotrast and the small number of malignancies and leukemias thus far reported." Undeniably, the thorium atom possesses a low alpha activity and an extremely long half-life. Since, in addition, it is retained by the reticuloendothelial system, it would be preferable to use another contrast substance if other things were equal. Other things are not equal, however, a point overwhelmingly proved by the more than 200 deaths associated with the only other family of contrast substances available for intravenous injection. The high efficiency of occlusion aortography allows the successful use of small doses, while the indications for coronary visualization are such as to confine the

procedure mostly to the genetically passé part of our population. Moreover, patients with serious coronary artery disease are unlikely to live long enough for chronic manifestations due to Thorotrast to develop, for, even if coronary surgery aided them, they would still be subject to death from other arteriosclerotic manifestations.

Perhaps the most important objection to the indiscriminate use of Thorotrast has nothing to do with its radioactivity. This is its tendency to produce fibrosis at sites of retention in the body. Fibrosis occurs following the inadvertent deposition of Thorotrast in perivascular tissues and, for this reason, its percutaneous administration should be avoided. In our technic for coronary visualization, injection is done through a catheter, eliminating the risk of extravasation. The use of small doses in elderly people virtually excludes radioactivity as a hazard. In any case, alternatives must be weighed. In the present situation the alternatives to Thorotrast are, first, drugs which offer a considerably greater risk to the patient and, second, the hazards associated with incompletely diagnosed coronary artery disease. It is to be hoped that the latter factor will become increasingly important as surgical skills are further developed and applied.

Other Technics for Coronary Visualization

Angiocardiography (55, 56) is not a useful means for studying the coronary arteries because of dilution of the contrast agent and superimposition of the images of simultaneously opacified pulmonary veins, left heart chambers, and aorta. Gordon, Brahms and Sussman (8) identified the coronaries in only 10 out of 1,200 angiocardiograms and di Guglielmo (16) found 12 instances in a series of 214 selective angiocardiograms. Only one out of 4,000 personally observed angiocardiograms led to the correct diagnosis of an intrinsic coronary artery lesion, a coronary arteriovenous fistula (34). Perhaps if we are lucky, angiocardiography may someday allow us to make a diagnosis of anomalous origin of a coronary artery; if the patient is also lucky, the diagnosis will have been suspected in advance and the injection of a suitable agent (yet to be discovered) will have been made by catheter into the base of the pulmonary artery between two occluding balloons. For the present, it is our considered opinion that angiocardiography is worse than useless in the study of coronary artery occlusion.

Cardiac ventriculography (1, 2, 29, 57, 58, 59) is capable of providing good opacity of the coronary vessels. Unfortunately, however, the vessels are partially obscured by even better opacification of the left ventricle. Injection is made through a needle inserted through the chest wall, pleural space, pericardium, right ventricular myocardium, and interventricular septum. Recent reports (58, 59) have described intramyocardial injections and electrocardiographic evidence of arrhythmias associated with the procedure.

Thoracic Aortography: From the beginning, it was apparent that the coronary arteries themselves would be difficult targets for the direct injection of opaque media. Accordingly, efforts were directed toward achieving the same result by injecting the contrast agent into the ascending aorta by one route or another. Other than the use of larger doses of newer but chemically comparable contrast agents, and larger catheters with modified tips, there has been no significant contribution to this method since Jönsson reported his modification of Radner's application of Rousthöi's approach to the coronary arteries. In their monograph (reworked in three subsequent publications), di Guglielmo and Guttadauro (16) sought out the coronary arteries in Jönsson's angiocardiograms and aortograms. Undeniably, the reproductions reveal good opacification by this method in selected cases, enabling the authors to make a useful contribution to their subject. The fact remains that the technic failed to produce recognizable opacifica-

tion in 30 per cent of the aortograms. Data are presented in such a manner that it is impossible to know the number of these cases in which only one coronary artery was visualized, but this can be assumed to be more than half. Better results have been achieved through the use of large-bore, thin-walled catheters, a modification suggested by Pearl in 1950. Beautiful studies have been done in the experimental animal by Vidone (60), Hughes *et al.* (24) and, from the same center, by Miller *et al.* (25). Their success is not entirely translatable to clinical practice, however, since in dogs proportionately larger doses may be injected more quickly than is justified or feasible in man.

Molnar and co-workers have used thoracic aortography for aortic valvulography (61). They designed an improved catheter tip with lateral orifices which resulted in fewer false positive diagnoses of aortic insufficiency. Thal (27, 28) has also exploited thoracic aortography in "human coronary sclerosis." Others, who preceded him in applying thoracic aortography to the study of man's coronary arteries, may be inclined to discount his statement (27) that "the blood vessels of the heart, however, have not yet been studied in coronary sclerosis of the living human, although coronary arteriograms have been obtained incidental to retrograde aortography."

In advocating a 1.5-second injection, through a No. 10 catheter, of 40 c.c. of 76 per cent Renografin, Thal exemplifies the general trend toward improvement of the quality of visualization by increasing the amount and concentration of the organic iodine-containing contrast substances employed. Since in thoracic aortography most of the injected material is immediately washed away from the coronary arteries, the method is obviously highly inefficient. In an effort to compensate for unpredictable distribution, dangerously large doses, all (or none) of which may enter the coronary arteries, must be used. Still another hazard is the required low position of the catheter tip, which poses a threat to the aortic valves during conventional thoracic aortography.

Controlled Vascular Occlusion

The first description of double-lumen balloon catheters for producing and studying controlled vascular occlusion in intact subjects is believed to have been that of Dotter and Lukas, who in June 1950 reported the effects of unilateral pulmonary artery occlusion in dogs (35). Different types of catheters (depending upon the relative position of balloon and sampling lumen) were devised, used, and subsequently placed on the market (by the U. S. Catheter and Instrument Corporation). Since that time, these and other types of balloon catheters have been employed for various experimental and clinical purposes, including contrast vascular visualization (23, 62–70). The angiographic appearance of pulmonary vessels proximal and distal to occluding balloons has been described in detail by Nordenström (62) and others (63, 64). In connection with their studies on unilateral pulmonary arterial occlusion in man, Brofman *et al.* (64) took a logical step by adding a third lumen to the cardiac catheter so that working lumens would be available both central and peripheral to the occluding balloon. Recently, Brofman and Elder (65) used a balloon catheter to enhance aortographic visualization of a cardioaortic sinus, distending the balloon with fluid so as to block the inferior vena cava while manually occluding circulation to the head and arms. Their purpose was to reduce left ventricular output and thereby minimize the dilution of radiopaque substance injected into the ascending aorta. Although the authors indicated that the resultant film was not entirely convincing (a point supported by their illustration), they increased the available knowledge in an area where much remains largely unexplored—controlled vascular occlusion in the intact subject. McAllister and Beck in 1950 (66) described the experimental use of an air-filled(!) intracardiac balloon as

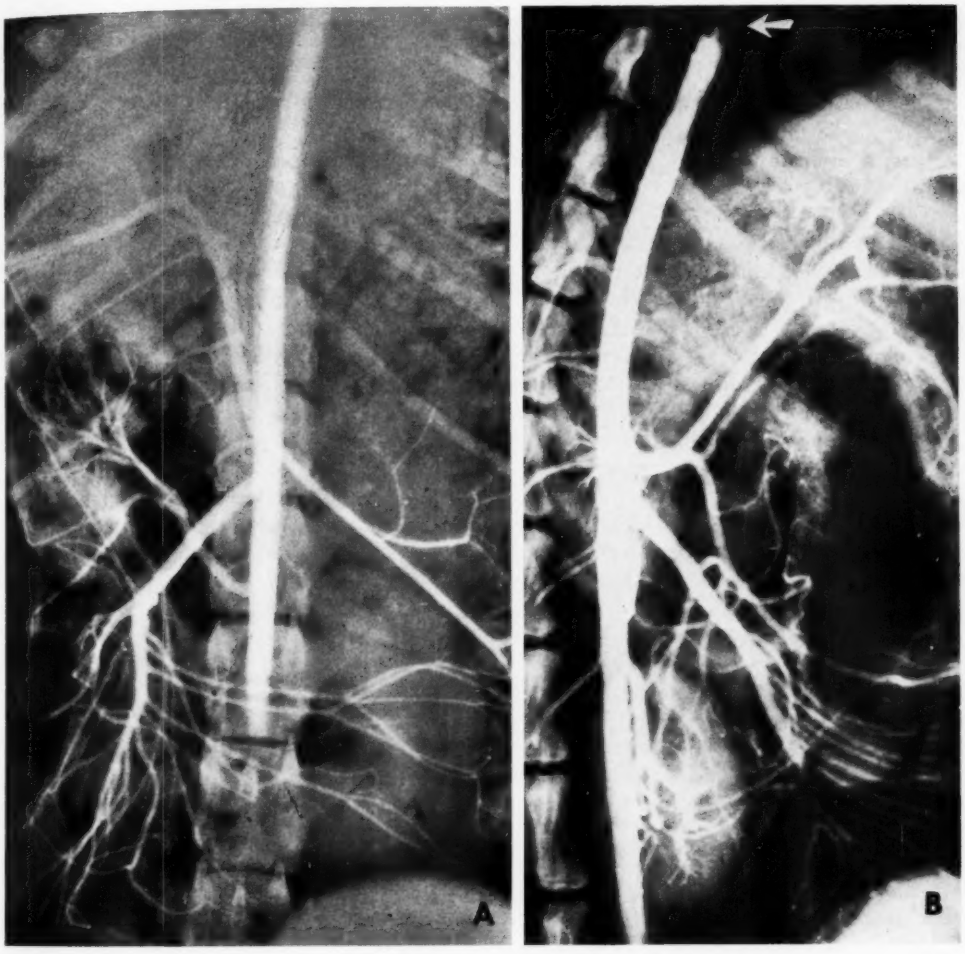


Fig. 13. Anteroposterior and lateral views of lumbar aorta, demonstrated by postocclusion or static angiography. Exposures were made during injection of 7 c.c. of 35 per cent Urokon distal to balloon inflated in lower thoracic aorta (arrow).

a form of contrast agent. The use of a balloon filled with fluid contrast agent, which is liberated by bursting the balloon at a selected location within the cardiovascular system, has been described by Brofman (67).

Our use of occlusion catheters for contrast cardiovascular visualization dates back to 1950, but was sporadic prior to the decision to take up the problem of coronary visualization. The direct results of these studies have been given above. Visualization of the descending aorta in dogs represents an interesting by-product of the coronary investigation. Figure 13 demonstrates the remarkable detail achieved by the injection of contrast substance distal to a point of arterial occlusion. It is not surprising that conventional aortography and arteriography often suffer from faulty timing when it is recalled that arterial blood flow during certain phases of the cardiac cycle exceeds 100 to 150 cm. per second. Thus, poor visualization may result from the first portion of the injected substance having left the arteries before the final part has been injected and the exposure

made. This cause of substandard visualization is completely eliminated by the use of postocclusion or static angiography. It is worth remembering that arteries opacified peripheral to a point of occlusion assume a half-empty state reflecting their intraluminal pressure and volume. Their size is reduced accordingly. Figure 14 illustrates the marked reduction in caliber of the circumflex coronary artery following obstruction of the orifice of the left coronary artery in a dog. This example of a striking change in cross section reveals why gross autopsy examinations and incorrectly prepared injection specimens may lead to erroneous conclusions concerning the presence of serious coronary arterial narrowing during life.

No discussion of either coronary visualization or balloon-produced vascular occlusion would be well documented without reference to an instrument described by Agress *et al.* in 1952 (68) and subsequently used for coronary arteriography. This consisted of a long, tubular metal sound bearing a balloon near its tip. Although it was designed to produce selective coronary embolization with microspheres (69), its potential use in coronary visualization was not overlooked.

In 1956, Cannon *et al.* (23) described coronary visualization in dogs by means of a procedure which is functionally quite similar to the one reported here, though there are several points of difference: (*a*) They failed to produce complete aortic occlusion (evidenced by heavy opacification of the descending aorta in reproductions accompanying the report). (*b*) They made use of a metal sound as opposed to a flexible cardiac catheter. While the sound, by virtue of its rigidity, simplifies the problem of maintaining the occluding balloon in the desired location, it has the disadvantage of necessitating an operation on the carotid artery, thereby adding to the hazard of the procedure. (*c*) Their method, like virtually all current contrast-visualization technics, makes use of an organic iodine-containing contrast substance. We fear that the use of such agents may force a choice between safety and reliability. In an unplanned throwback to Rousthöi and Radner, we now employ Thorotrast as the lesser of two evils.

Our approach and that used by O'Loughlin at The University of California, Los Angeles, are remarkably similar, although they originated independently. O'Loughlin now uses a balloon catheter which is much like ours, although a conceptual descendant of Agress' sound. We take this opportunity of gratefully acknowledging O'Loughlin's willingness to exchange unpublished information. His successful use of a gas rather than a fluid to distend the occluding balloon dispelled doubts which had delayed our change to this desirable feature of the technic. It is our understanding that his experience with the method and its application has been similar to ours.

Other Applications of Vascular Occlusion Technics

Future possibilities include the use of smaller, more flexible, twin-balloon catheters to allow not only the visualization of previously inaccessible vessels but also to provide for selective withdrawal of blood samples and the exclusive introduction of drugs into the vessel lumens. The effects of selective, controlled vascular occlusion could be extended to include many structures that previously could be occluded only by surgical ligation.

Elective Cardiac Arrest for Coronary Visualization

Acetylcholine specifically inhibits myocardial activity. A very small amount injected into the lumen of a coronary artery will usually produce immediate cardiac arrest (71–74). Inasmuch as the drug is rapidly destroyed by metabolic processes, it can be said to have a built-in safety factor. So rapid is the rate of inactivation of acetylcholine within the myocardium, that virtually no active drug escapes into the general circulation to cause undesirable side effects. Drs.

Charles Bailey and J. S. Lehman first drew our attention to the *application of acetylcholine-induced cardiac arrest to visualization of the coronary vessels in the intact patient,* a technic originally reported by Arnaulf (75). At the time, the studies of Baily and Lehman had progressed to the point that several patients suffering from coronary disease had been studied with considerable success. Injection was made into the aorta through direct transthoracic needle insertion. Precautionary preparations were made for emergency thoracotomy in the event of persisting arrest. This did not occur. We wish to thank Bailey and Lehman for sharing their unpublished experiences with us. As a result, we have now gained sufficient laboratory experience with acetylcholine-induced cardioplegia as an adjunct to contrast visualization to form a favorable opinion.

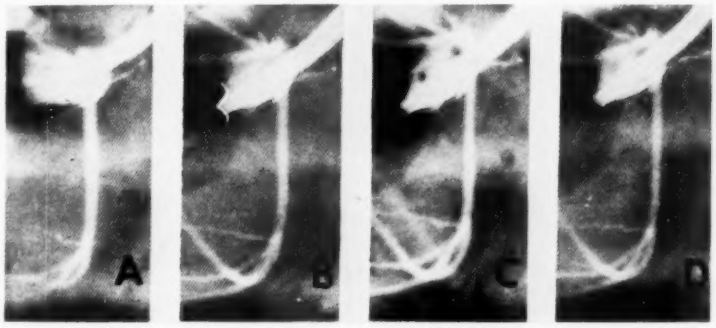


Fig. 14. Progressive reduction in size of circumflex branch, due to obstruction of left coronary ostium by tip of catheter.

The balloon catheter promises to provide the required safety factor for a number of highly promising applications of this technic. By means of the catheter it will be possible at a moment's notice to overcome acetylcholine-induced cardiac arrest through the injection of atropine, a specific and adequate antidote.

With the original technic, patients who had been given acetylcholine by direct injection into the proximal (unobstructed) aorta had required one or more 25- to 50-mg. doses of the drug. In our dogs, aortic occlusion has allowed precise administration of the acetylcholine, with the result that only 0.5 mg. was uniformly effective on the initial injection. In all cases, the arrest was spontaneously terminated within fifteen seconds of its onset. No alarming abnormal rhythms were encountered and normal sinus rhythm was present a few seconds after the first returning beat following arrest. We injected our routine 5 c.c. volume of Thorotrast along with the acetylcholine. Exposures were made as soon as arrest was established and periodically thereafter. This technic produced remarkably good films of the coronary arteries (Figs. 15 and 16). It was perfectly apparent from serial study that reduced forward coronary flow continued after the heart had stopped beating.

Miller *et al.*, in April 1957, published a coronary angiogram made just before the beginning of induced arrest in a dog. This film shows cardiac motion. They also included three other coronary arteriograms which had been taken during ventricular fibrillation following coronary surgery done under elective cardiac arrest produced with potassium chloride. On these films, the appearance of the coronary arteries resembles that exhibited by the vessels in films we have made during acetylcholine arrest. The use of acetylcholine for the production of elective cardiac arrest experimentally and in conjunction with cardiac surgery has been reported by Moulder, Mondini, Lam, and their respective associates (72–74). In so far as we are able to learn, its first use specifically for contrast

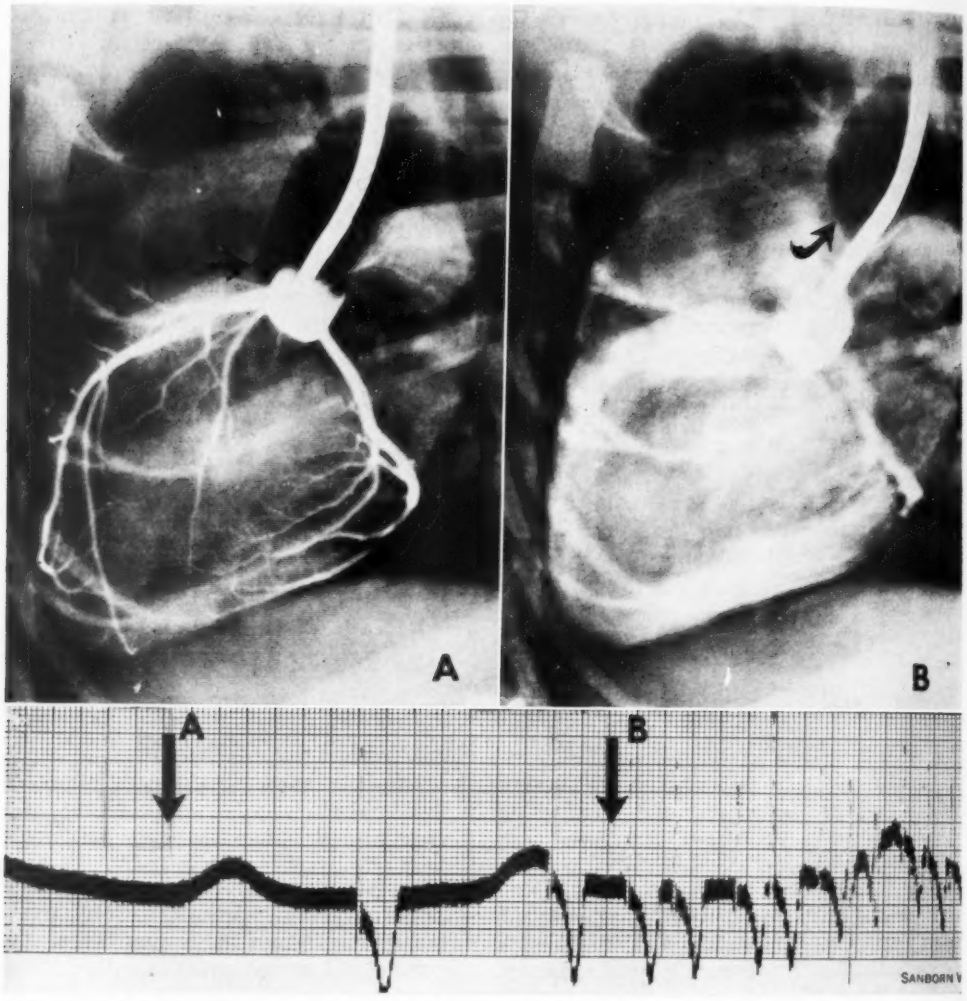


Fig. 15. Elective cardiac arrest induced with 0.5 mg. acetylcholine.
A. Coronary arteriogram during cardiac standstill. Only left coronary is opacified, due to low position of balloon.
B. Heartbeat resumed, causing distal migration of balloon. Note dense myocardial "blush," analogous to capillary phase of cerebral arteriography.

visualization was that related to us by Lehman and Bailey in citing the work of Arnaulf.

If the use of acetylcholine-induced cardiac arrest continues to be as safe and effective as it has been in the past, it promises to be one of the most important advances in cardiovascular visualization since Robb and Steinberg's contribution. Visualization during cardiac arrest should allow precise stereoscopic delineation of the size and shape of hitherto invisible defects within the heart and its vessels. During life, left-right shunts within the heart have tended to defeat the purpose of angiocardiography by diluting the contrast substance. Controlled cardiac arrest will make it possible to alter the physiology to suit the technic and suspected lesion. Use of the occlusion catheter without cardiac arrest should also enable the demonstration of intracardiac shunts

by contrast visualization in association with deliberate alterations of normal pressure relationships. An extension of balloon catheter technics leads to the interesting and dramatic conclusion that there now exists a means for restoring "life" to selected individuals after clinical death has in fact occurred. For example, in massive acute myocardial infarction, occlusion catheters could be positioned in the ascending aorta and pulmonary artery and would allow for complete exclusion of the heart at any desired time (including up to two minutes after death). It would therefore be possible to use an artificial pump oxygenator to take over the circulation of blood. Actually, though the foregoing seems fantastic, there is better reason to question its advisability than its feasibility. At present, it would appear that restoring the individual following lethal myocardial infarction would be less of a problem than maintaining him.

In summary, the use of occlusion catheters for selectively excluding or gaining access to various portions of the cardiovascular system promises to have considerable future impact on experimental and clinical medicine.

SUMMARY

The development of improved methods for the radiographic demonstration of the coronary vessels in man is one of radiology's most pressing responsibilities. Once this has been achieved, there should result a significant acceleration toward what is hoped will be a successful surgical attack upon coronary artery disease.

Occlusion aortography, a new technic for coronary arteriography, makes use of a special double-lumen balloon catheter to inject a small quantity of contrast agent (Thorotrast) close to the orifices of the coronary arteries during brief but total occlusion of the aorta just peripheral to the injection site. Since all the contrast agent enters the coronary arteries, maximum efficiency is achieved.

Experimental observations during more than 500 complete aortic occlusions and 350 injections in 51 dogs support our belief that this technic is safe and reliable.

The increased efficiency of occlusion aortography for coronary visualization allows the use of small volumes of relatively dilute agents in obtaining improved visualization routinely instead of sporadically. By comparison, thoracic aortography constitutes a less efficient and more hazardous method for coronary visualization in that it involves the relatively uncontrolled intra-aortic injection of ten to twenty times the needed amount of a type of contrast substance which has caused over 200 reported fatalities.

The use of occlusion catheters in gaining controlled access to the cardiovascular system promises to open up many unexplored clinical and experimental areas of importance, examples of which are (*a*) new technics for cardiovascular visualization, (*b*) elective controlled cardiac arrest in the intact subject for purposes such as cardiovascular visualization, and (*c*) total cardiopulmonary bypass as an emergency therapeutic measure in the intact patient.

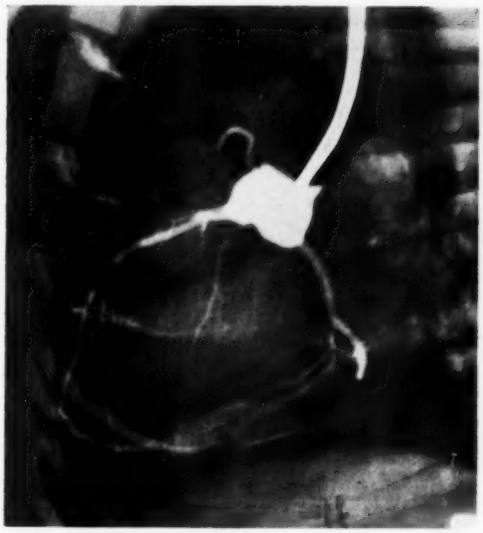


Fig. 16. Coronary arteriogram during elective cardiac arrest produced with 0.5 mg. acetylcholine.

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SUMMARIO IN INTERLINGUA

Visualisation Del Circulation Coronari Per Aortographia Occlusional

Le disveloppamento de meliorate methodos pro le demonstration radiographic del vasos coronari in humanos es un del plus urgente responsabilitates del radiologo. Post que iste objectivo es attingite, on pote expectar un acceleration significative in le progresso verso le realisation del separate successo in le attacco chirurgic contra le morbos coronari.

Le aortographia occlusional es un nove technica de arteriographia coronari que utilisa un ballonate catheter biluminal de construction special pro injicer un micre quantitate de substantia de contrasto (Thorotrast) proxime al orificios del arterias coronari durante un breve sed total occlusion del aorta a un sito justo peripheric in relation al sito del injection. Proque le totalitate del agente de contrasto entra in le arterias coronari, le resultante efficacia es maximal. Observationes experimental in plus que 500 complete occlusiones aortic e 350 injectiones in 51 canes supporta le opinion que iste technica es salve e fidel.

Le augmentate efficacia producite per le aortographia occlusional in le visualisation coronari permitte le uso de micre quantitates de relativemente multo diluite agentes in le obtention routinari plus tosto que sporadic de un visualisation meliorate. Comparate con iste technica, aortographia thoracic constitue un minus efficace e plus riscose methodo de visualisation coronari, proque illo require un relativemente non-regulate injection intra-aortic de grande quantitates—dece a vinti vices plus grande que le aortographia occlusional—de un typo de substantia de contrasto que ha causate plus que 200 reportate mortes.

Le uso del catheter occlusional pro obtener un regulate accesso al system cardiovascular promitte aperir numerose inexplorate areas clinic e experimental de grande importantia. Exemplos de illos es (a) le disveloppamento de nove technicas in le visualisation cardiovascular, (b) le elective e regulate arresto cardiac in subjectos intacte con le objectivo de un tal visualisation cardiovascular, e (c) le circumcursion cardiopulmonar total como mesura therapeutic de urgentia in le patiente intacte.

Roentgen Examination of the Gastrointestinal Tract as an Aid in the Diagnosis of Acute and Subacute Reticuloendotheliosis[1]

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IN THE THIRTY-FOUR years since Letterer (21) and twenty-five years since Siwe (44) reported the entity now known as Letterer-Siwe's disease, numerous articles on the subject have appeared in the literature (1, 5, 18, 23, 27, 28, 29, 35, 37, 38, 40, 41, 45, 48, 49, 50). There have also been many papers correlating Letterer-Siwe's disease, Hand-Schüller-Christian disease, and eosinophilic granuloma under the general designation nonlipid histiocytoses, histiocytosis-X, or reticuloendotheliosis (2, 3, 6, 9, 11, 13, 15, 23, 24, 25, 50). It is not our purpose to restate the well documented clinicopathologic relationship of the "triad" (23, 24). Instead, we shall describe an as yet unrecognized roentgen finding in the gastrointestinal tract in the acute and subacute phases of the disease. We do not believe this is simply an isolated, impractical observation. With the increasing frequency of recognition of atypical cases, both in infants and adults, in which the gastrointestinal symptoms are often prodromal (4, 8, 16, 17, 18, 22, 27, 28, 29, 33, 34, 45, 48), the roentgen examination of the upper alimentary tract may give the initial clue, leading to the performance of accepted laboratory procedures for a final and positive diagnosis.

Among the eight criteria originally listed by Siwe, no mention was made of the gastrointestinal tract *per se*. A diagnosis based on classical skin, node, pulmonary, bone, or reticuloendothelial histopathology has been described and refined from clinical, pathological, and roentgen points of view (1, 19, 20, 23, 24, 35, 38, 41, 43, 44, 49, 50).

A recent case at the University of Minnesota Hospitals was of special interest not only because of the classical findings but also because of the gastrointestinal symptoms, which chronologically antedated the typical manifestations of the disease (Case I). The illness began at two months of age with vomiting and obstructive symptoms. Later, a typical skin rash appeared over the trunk and adenopathy developed. Mononuclear infiltration of skin and marrow were found even though the nodes were negative. When the child was first seen, the problem was one of emaciation and fluid loss through vomiting and loose stools. An upper gastrointestinal examination showed marked changes in the mucosa from the level of the second portion of the duodenum through the ileum. The mucosal pattern was completely coarsened, with a pebble-like appearance (Figs. 1-3). This was interpreted as indicative of intestinal infiltration by the underlying process as well as possible mesenteric node replacement resulting in complete interference with small-intestinal physiologic processes. Postmortem findings confirmed the extensive gastrointestinal invasion.

With this in mind, a patient with subacute reticuloendotheliosis (Case II) was recalled to the department for examination of the gastrointestinal tract. She had survived some twenty-eight months with middle-ear involvement, recurrent lymphadenopathy, and massive bone invasion, but without gastrointestinal symptoms. Nevertheless, a small-intestine survey showed generalized absence of normal mucosal pattern, segmentation of intestinal loops, and barium flocculation interpreted as representing mesenteric node involvement rather than intestinal wall invasion, not unlike the picture in disordered motor physiology of the small intestine due to other causes (12).

In view of the findings in these two cases, the records of the University of Minnesota Hospitals were reviewed. Unfortunately, the hospital record department

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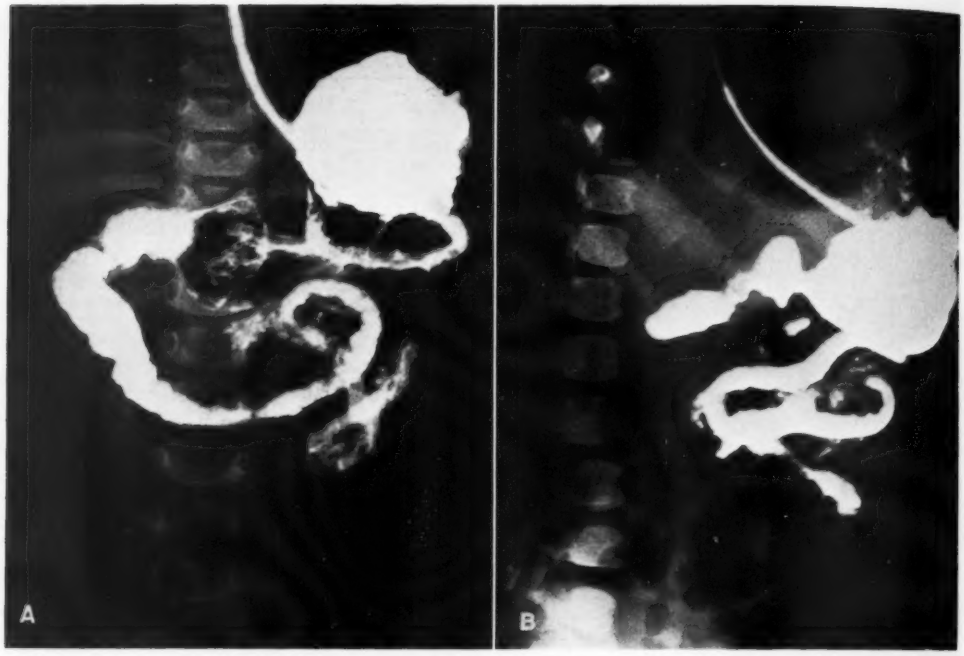


Fig. 1. Case I. Nine-month-old male whose illness began at two months of age with vomiting and distention. Loose stools were also a problem. Two months later the typical skin lesions of Letterer-Siwe's disease developed over the trunk and scalp.

A. Anteroposterior view of abdomen showing complete loss of mucosal pattern of duodenal loop and proximal jejunum. The walls lacked pliability and showed marked mucosal effacement, with thickening and fine serration.

B. Lateral abdominal view shows the same upper intestinal changes.

uses the A.M.A. nomenclature system, which more or less excludes the reticuloendothelioses. As a result, the charts which were positively identified were located by devious routes, and it seems certain that some records were "lost" due to the shortcomings of the accepted coding system.

Between 1932 and 1957, 22 proved cases of reticuloendotheliosis were found. Of these, 6 were of the Hand-Schüller-Christian type, 5 were transitional between the Hand-Schüller-Christian and Letterer-Siwe types, and 11 were of the Letterer-Siwe group. Eosinophilic granulomas were not included. In 4 of the 6 Hand-Schüller-Christian cases there was bone involvement; all of the 5 transitional cases but only 3 of the 11 Letterer-Siwe cases showed bone changes. Seven of the 11 patients with acute reticuloendotheliosis were found to have intestinal and/or mesenteric node involvement at autopsy. Six of the 7 had exhibited gastrointestinal symptoms, *i.e.*, vomiting, distention, or diarrhea. One of these was an adult. Two of the transitional cases had autopsy proof of intestinal and/or mesenteric node involvement but were without symptomatology. One of this group is still living (Case II). In 1 of the 6 chronic cases there was intestinal and/or mesenteric node involvement without symptomatology. All but one of the patients had typical skin changes.

After a review of our 22 cases, it seems evident that the acute reticuloendothelioses are the ones which are most likely to be present with gastrointestinal symptomatology. Likewise, these patients are less likely to show destructive bone changes. The transitional cases can be expected to be intermediate in symptomatology. The chronic cases are the least likely to have gastrointestinal findings and most likely to

have chronic bone, ear, and hematoporitic changes.

It was not our purpose to review all the cases in the literature, but 114 which could be definitely documented as acute or subacute reticuloendothelioses were collected, of which 7 were in adults (3, 11, 23, 36, 42, 46). One patient had clinical and pathologic findings of duodenal obstruction, 1 had clinical "obstruction" but the roentgen scout film showed generalized intestinal distention, and 6 had presenting findings of diarrhea (4, 8, 16, 17, 18, 22, 27, 29, 33, 34, 45, 48). Pathologically, 13 showed intestinal invasion and 2 showed questionable intestinal involvement; 8 had mesenteric adenopathy exclusive of intestinal invasion. Some of the defects were due to mononuclear cell invasion of the mucosa and intestinal wall; in other cases there were also mucosal petechiae. Peyer's patches were replaced in some instances. This amounted to approximately 20 per cent involvement of gastrointestinal tract and/or mesentery, though it is acknowl-

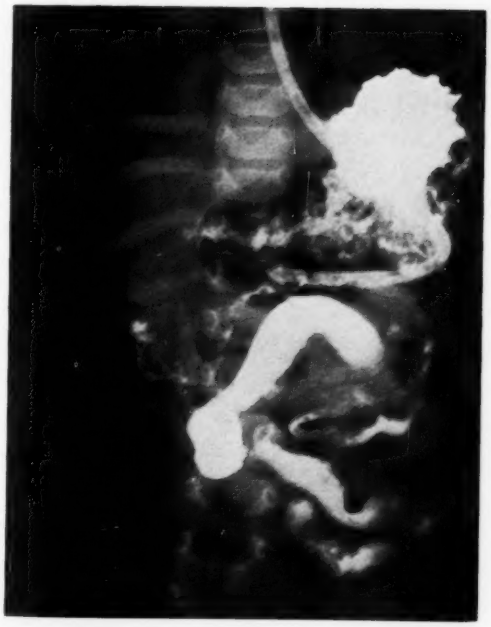


Fig. 2. Case I. The jejunum shows the same changes throughout, with persistence of deformities in upper gastrointestinal tract.

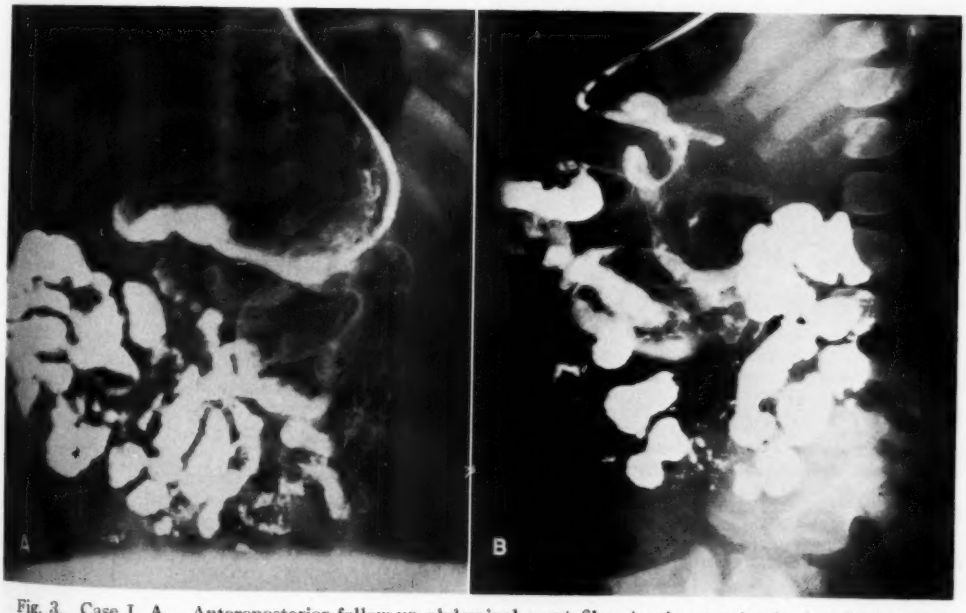


Fig. 3. Case I. A. Anteroposterior follow-up abdominal scout film showing previously described changes through the proximal ileum. The distal ileum shows segmentation of loops and barium flocculation, with less striking wall and mucosal alterations.
B. Lateral view of abdomen taken at the same phase of the examination.

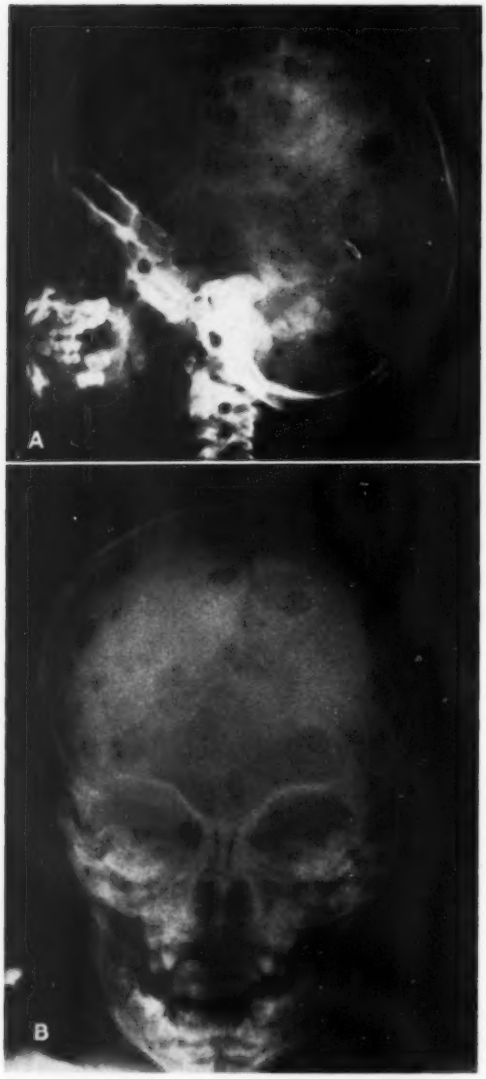


Fig. 4. Case II. A three-and-one-half-year-old female first seen at twelve months of age with chronic left otorrhea, temporal and parotid swelling, temperature elevation, adenopathy, and hepatosplenomegaly. During her twenty-eight months of observation, she was hospitalized nine times because of exacerbation of the original findings (see text).

A. Lateral view of skull taken in late phase of disease, showing multiple characteristic zones of bone destruction quite typical for reticuloendotheliosis. Original examination showed involvement limited to left temporal and frontal bones. The mandibular body showed expansile changes as well. These early findings progressed to above proportions and later regressed.

B. Frontal projection of skull showing above findings in other plane.

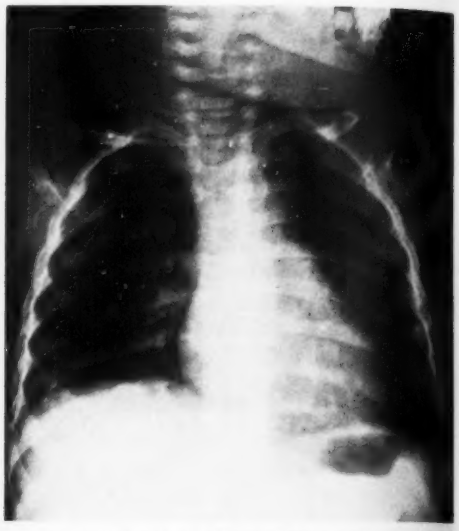


Fig. 5. Case II. Chest film showing multiple sharply demarcated zones of bone destruction and cortical expansion in both shoulder girdles and rib cage.

edged that this is not a statistically valid figure.

CASE REPORTS

CASE I: J. M. was first seen at the University of Minnesota Hospitals when he was nine months old, at which time he had a seven-month history of chronic illness.

Vomiting and abdominal distention developed at two months of age, and fluid loss through vomiting and stools persisted throughout the course of the illness. Though loose stools were not a major complaint of the mother, these were frequently observed in the hospital. At three months, the classical papular eruptions appeared over the trunk and scalp. Abdominal ascites and dependent edema also developed. Adenopathy was an insignificant finding.

Because of the vomiting and distention, a gastrointestinal tract examination was done. The small and large intestine appeared moderately distended, suggesting adynamic ileus. The esophagus and stomach were grossly normal, though the presence of a gastric tube prevented a complete evaluation of the stomach. Marked abnormality of the mucosa of the duodenal loop and proximal jejunum was immediately obvious. The mucosal pattern was completely effaced in some zones and finely granular in others, suggesting hypertrophy and/or edema of the intestinal walls (Figs. 1–3). No fragmentation or segmentation of the small intestinal loops was present until the meal entered the ileum (Fig. 3a).

Skin biopsy showed changes diagnostic of acute

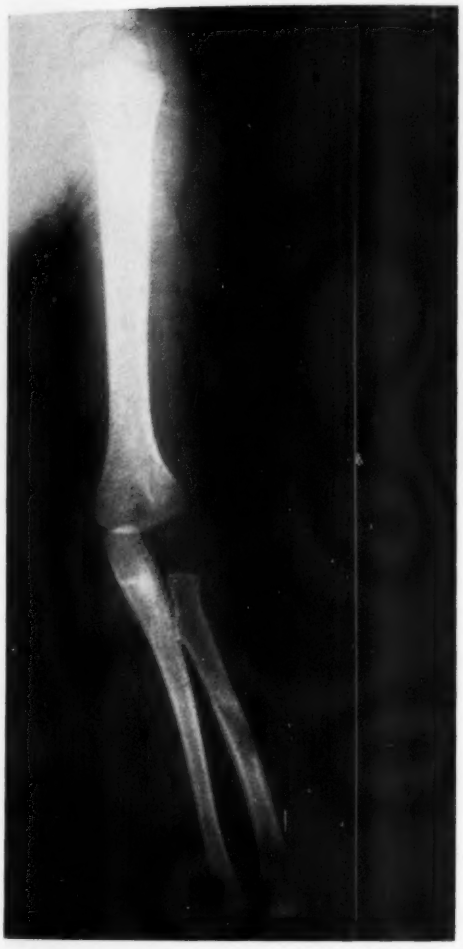


Fig. 6. Case II. Irregular zones of bone invasion and replacement in middle and distal thirds of radius and distal ulna.

reticuloendotheliosis, *e.g.*, heavy mononuclear cell involvement. The bone marrow revealed large mononuclear reticulum cells and an increase in megakaryocytes. Lymph-node biopsies were negative.

Laboratory studies showed hypoalbuminemia associated with protein loss and disturbed intestinal absorption, which accounted for the ascites and peripheral edema. This was treated with albumin and plasma, with no apparent effect.

Postmortem findings included diffuse replacement of liver substance and thickening of the small-intestinal wall by reticuloendothelial mononuclear cell invasion.

CASE II: D. A. J. was one year old on admission, Sept. 9, 1955, at which time she had a six-week history of left parotid and temporal swelling with temperature elevation. Physical findings included left otorrhea, left parotid and temporal swelling (3 and 1 cm., respectively), enlargement of the liver and spleen, and generalized adenopathy.

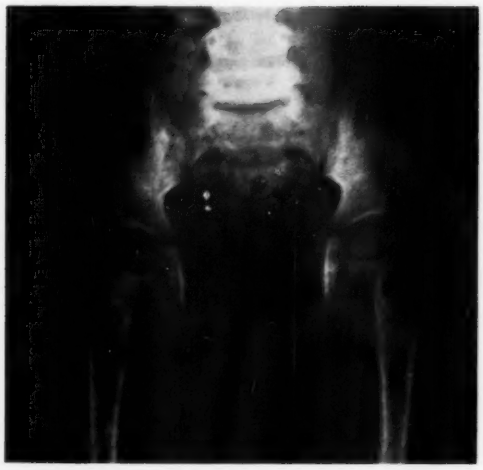


Fig. 7. Case II. Healing phase after irradiation to right hip and Amithopterin therapy, as seen in both ischial bones, right ilium, both pubic bones, and proximal femora.

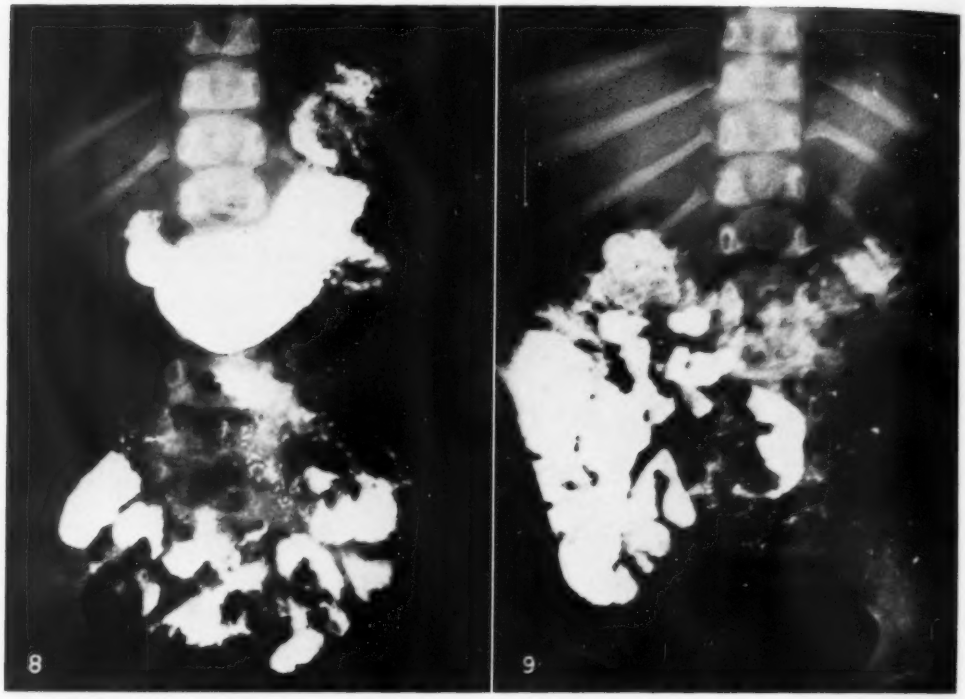
The hemoglobin was 9.1 gm., white blood cell count 6,200, and sedimentation rate 31 mm. in an hour.

Roentgenograms originally showed an area of destruction in the left temporal and frontal regions, and later zones of general destruction in the skull (Fig. 4). Lytic areas and cortical expansion were present in the mandible, ribs, shoulder girdles, long bones, and upper and lower extremities and pelvis (Figs. 5–7), which were diagnostic for reticuloendotheliosis. Node biopsy was positive for acute reticuloendotheliosis.

Two courses of x-ray therapy were given, one to the left temporal region and one to the pelvis.

Between Jan. 4, 1956, and March 26, 1958, the patient had nine more hospital admissions due to exacerbations of the initial findings. The usual problems with each subsequent admission were temperature elevation up to 102 to 104° F., reddening and increase in size of the nodes, elevation of the erythrocyte sedimentation rate to 121 mm. in an hour, anemia with hemoglobin down to 8.2 gm., requiring transfusions, leukopenia, and alternating worsening and improvement of bone lesions. Amithopterin, Metacortin, and antibiotics were given. The course of the disease suggested a transition from acute to subacute reticuloendotheliosis.

In December 1957, during a period of remission, the patient was recalled for upper gastrointestinal examination. This showed a normal esophagus, stomach, and duodenum; minimal coarsening of the



Figs. 8 and 9. Case II. Fig. 8 Interval small-intestine examination when patient was in state of remission. Proximal jejunum showed almost normal mucosal pattern except for minimal coarsening. Distal jejunum and ileum showed persistent segmentation and mucosal coarsening of the intestinal loops.

Fig. 9. Late film shows same disturbance of the small-intestine pattern. This was not transitory as in functional disturbed motor physiology, but was a constant finding throughout in spite of the patient's relatively good health at the time. This was considered to indicate mesenteric involvement rather than actual intestinal wall or mucosal invasion.

jejunal mucosa; definite segmentation of the distal jejunum and ileum, with persistent coarsening of the mucosa, suggesting mesenteric invasion, probably due to adenopathy (Figs. 8 and 9). A tenth exacerbation was manifested by further bone destruction.

DISCUSSION

Admittedly, one would not consider a gastrointestinal examination a necessity in the diagnosis of reticuloendotheliosis if classical ear, skin, bone, liver, spleen, pulmonary, lymph-node, and hematopoietic findings were obvious. It is apparent, however, from the University of Minnesota Hospital cases, as well as from a survey of reports in the literature, that the incidence of gastrointestinal and mesenteric node involvement is rather high. Even though prodromal symptomatology was referable to the gastrointestinal tract in many children and adults (4, 8, 16, 17, 18, 22, 27, 29, 33, 34, 45, 48), roentgen examinations were not done. Since typical roentgen evidence for bone destruction is usually not present in acute reticuloendotheliosis, it seems to us that this simple procedure could point the way to an earlier diagnosis of the disease.

If one checks the pathology protocols, one can readily understand the likelihood of roentgen manifestations of the underlying gastrointestinal changes in reticuloendotheliosis. Where diarrhea is a presenting symptom, as in Case I, massive invasion of the intestinal mucosa, with hypertrophy of mucosa and Peyer's patches and some replacement with mononuclear cells, not only alters the wall contours, pliability, and mobility, but also interferes with absorption. In the more chronic form, where the intestinal wall *per se* is spared, one may well find involvement of the mesenteric nodes. This is probably

true of our second patient with disturbed intestinal physiology not unlike the nonspecific problem in amyloid disease, mesenteric metastases, or even Whipple's lipodystrophy (12).

In the differential diagnosis, one must consider celiac syndrome, sprue, enteritis, and disturbed motor physiology on a nutritional basis as the most likely possibilities. Apart from the laboratory and clinical differences, the large, foamy, foul-smelling stools of the first two are not present in the reticuloendothelioses. Nor is the marked emaciation typical of these two conditions found until late in the course of reticuloendotheliosis, by which time the usual skin, node, or bone changes are obvious. The bloody diarrhea of enteritis, with segmental induration and alteration, is not present in the histiocytoses. Instead, there are vomiting, some ileus, and watery diarrhea.

The picture of disordered motor physiology (12) is the one most likely to be confused with the more chronic form of histiocytosis. One cannot distinguish this from the roentgen picture alone; nevertheless, clinical and laboratory studies following the initial roentgen clue or a return to a normal roentgen picture after alleviation of the emotional or nutritional problem would be of help. The fragmentation and segmentation of the barium within the intestinal loops and the altered mucosal pattern in the reticuloendothelioses would persist due to mucosal and mesenteric node involvement. Admittedly, in adults, with the subacute form of the disease, amyloidosis or metastases to the mesentery would be somewhat more difficult to differentiate.

Therapy in these entities is quite discouraging. Roentgen rays, colloidal radioactive gold (Au^{198}), antibiotics, and the steroids (4, 7, 10, 14, 26, 30, 31, 46, 47) have all been used with some degree of success, but the outlook in the acute forms remains poor at the time of this writing. X-ray therapy to the abdomen in our first case resulted in temporary improvement in the vomiting and diarrhea.

SUMMARY

A hitherto unrecognized roentgen finding prompted advocacy of routine upper gastrointestinal tract examination as an aid in the diagnosis of atypical reticuloendothelioses in which prodromal vomiting and diarrhea may be the only clinical symptoms.

Two recent cases of reticuloendotheliosis, one acute and one subacute, were responsible for the present study. The initial findings in the acute case were gastrointestinal. The small-intestinal pattern was completely changed due to invasion. The second case showed only moderate intestinal changes.

Twenty-two proved cases of reticuloendotheliosis were found in the University of Minnesota files. Of these, 11 were acute, and in 7 of these there was intestinal and/or mesenteric node invasion. Six of the 7 patients had had clinical gastrointestinal symptomatology.

Over 20 per cent of the verified cases in a survey of the literature had autopsy evidence of intestinal and/or mesenteric node involvement.

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SUMMARIO IN INTERLINGUA

Le Roentgeno-Examine Del Vias Gastrointestinal Como Adjuto In Le Diagnose De Acute E Subacute Reticuloendotheliosis

Un previemente non recognoscite constatation roentgenologic suggereva le uso routinari de examines del vias gastrointestinal superior como adjuta in le diagnose de reticuloendotheliosis atypic in que le occurrentia prodromal de vomito e diarrhea pote esser le sol constatation clinic.

Duo recente casos de reticuloendotheliosis—le un acute, le altere subacute—esseva responsabile pro le presente studio. Le constatationes initial in le caso acute esseva gastrointestinal. Le configuration del intestino tenue esseva completemente alterate in consequentia de invasion. Le secunde caso exhibiva solmente moderate grados de alteration intestinal.

Vinti-tres provate casos de reticuloendotheliosis esseva trovate in le archivos del Universitate Minnesota. De istos, 11 esseva acute, incluse 7 con invasion nodular intestinal e/o mesenteric. Sex del patientes habeva habite un symptomatologia clinic gastrointestinal.

In un revista del litteratura, plus que 20 pro cento del casos verificate esseva distinguite per provas necroptic de affection nodular intestinal e/o mesenteric.

Pericardial Celomic Cyst

A Re-Evaluation[1]

LIEUT. COL. GEORGE F. LULL, Jr., M.C.

RECENT EXPERIENCES with lesions present in the anterior mediastinum led to a review of the cases of pericardial celomic cyst recorded in this department in an attempt to reach some conclusion as to what diagnostic procedures are justified beyond proving that such a cyst does, in truth, arise in the thorax and is not an inoperable malignant growth. This investigation was stimulated by Funch and Wenger's (1) advocacy of tapping of cystic lesions and injection of air for contrast studies and for examination of the fluid contents. There was also a feeling that the exact designation of a cystic lesion preoperatively was little more than an academic exercise and that, for that reason, too zealous pursuit might be unwarranted.

Many authors (2–6) have pointed out the difficulty of the roentgen diagnosis of pericardial celomic cyst among the mass lesions in the anterior inferior mediastinum. Cooper, Archer, and Mapp (6) enumerated eleven other possibilities in this location: fat pad, lipoma, dermoid, teratoma, neurofibroma, diaphragmatic hernia, eventration of the diaphragm, cardiac aneurysm, sacculated pericarditis, primary pulmonary neoplasm, and metastatic cancer. Laipply (7) lists eight types of congenital cyst which may be present in this area: epidermoid, dermoid, teratoid, bronchial, esophageal, gastroenteric, pericardial celomic, and lymphangiomatous.

This problem did not become important until Pickhardt (8), in 1934, reported the successful removal of a cyst from the chest of a fifty-three-year-old woman who complained of sharp, knife-like pericardial pain, and whose chest film showed a circular shadow just above the left diaphragm. Lambert (9), in 1940, by a process of exclusion, established the entity of pericardial celomic cyst and presented a theory as to its origin. He postulated the persistence, as a separate cavity, of one of the mesenchymal lacunae which, in the developing embryo, fuse to form the pericardial celom. Lillie *et al.* (4) have since expanded this theory to explain the formation of pericardial diverticula and of lesions diagnosed as pericardial celomic cyst which were found more superiorly situated in the anterior mediastinum than the cardiophrenic sulcus.

Lambert, in his process of exclusion, indicated that the distinction between pericardial celomic and lymphangiomatous cysts was not to be made on a histologic basis, since it was impossible to distinguish between mesothelium and endothelium. He implied, therefore, that gross appearance must be used in differentiation. He described lymphangiomatous cysts as multilocular, and intimately associated with the structures with which they are in contact (*i.e.*, adherent). He stated further that attempts at their removal are accompanied by profuse bleeding because of the multiple sources of the blood supply.

Several writers have used Lambert's article as a basis for their reports. Apparently, Funch and Wenger's advocacy of tapping anterior mediastinal cysts stems from this. They describe the cyst in their case as unilocular, with paper-thin walls, with no tumor in the wall, no communication with the pericardial sac, and complete filling with thin clear fluid. "These findings," they state, "excluded lymphangiomatous cyst."

The premise that multilocularity in thin-walled cysts excludes pericardial celomic cysts and indicates lymphangiomatous cysts is invalid in our experience. Cases 8 and 14 of the present series were multilocular but in all other respects qualified as

[1] From the Radiology Service, Fitzsimons Army Hospital, Denver, Colo. Accepted for publication in March 1958.

TABLE I: PROVED PERICARDIAL CELOMIC CYSTS

Case Number	Sex	Age	Objective Symptoms	Location	Separate Shadow	Prior Neg. Film	Comments
1	M	30	Yes	L	Yes	Yes	
2	M	45	Yes	L	Yes	Yes	
3	M	32	No	R	Yes	Yes	Fine adhesions to pericardium and diaphragm
4	M	27	No	R	Yes	Yes	Large cyst appeared lobulated on roentgenogram
5	M	29	No	R	Yes	Yes	Cyst pyramidal in shape on roentgenogram
6	M	32	No	R	Yes	Yes	
7	M	34	No	R	Yes	Yes	
8	F	49	No	R	Yes	Unknown	Tendency to multilocularity. Armed Forces Institute of Pathology concurred
9	F	33	No	R	Yes	Unknown	
10	M	20	Yes	R	Yes	Yes	Small cyst on diagnostic pneumothorax. Loculated pleural effusion suggested in oblique view
11	M	24	Yes	L	Yes	Yes	
12	F	43	No	R	Yes	Yes	
13	M	23	Yes	R	Yes	Yes	Microscopic multilocularity. A typical lining of islands of flat cells in granular and amorphous material
14	F	32	No	R	Yes	Unknown	Surgical impression of bronchial cyst. Pathologist reported multilocular, very thin-walled cyst lined by flat cells of undetermined origin. No other features of bronchial or enteric cyst
15	M	21	Yes	R	Yes	Yes	

pericardial celomic cysts, according to the pathologists; there is nothing in their radiographic appearance to indicate their locularity. Cases 17 and 18 were lymphangiomatous cysts which proved to be unilocular on gross examination.

Maier (10), in 1955, also questioned the acceptance of multilocularity as a diagnostic criterion for lymphangiomatous cysts. "This," he wrote, "would seem to be an arbitrary distinction since the typical microscopic findings of a lymphangioma may be encountered in the wall of a thin unilocular cyst," though he points out that sometimes only small portions of the wall show the features which indicate its lymphangiomatous origin.

Bradford, Mahon, and Grow (2) set up three criteria for the diagnosis of pericardial celomic cyst; a thin wall, clear fluid contents, and a lining of endothelium or mesothelium that may look quite like epithelium. These criteria do not require that the cyst be unilocular, they do not include any consideration of adherence to surrounding structures, nor do they define any specifications with respect to blood supply. Obviously, they involve both gross and microscopic identification, but an attempt at correlation with the radiographic features must be made. It is felt that similar features in lesions of different etiology must be understood for intelligent analysis of the roentgen findings.

In the Radiology Service of the Fitzsimons Army Hospital 15 cases have been recorded as pathologically proved pericardial celomic cyst. Certain of their features are summarized in the accompanying table. All have the radiographic appearance of anterior inferior mediastinal cystic lesions. Minor variations in contour are noted under the heading "Comments." Since all are fairly characteristic in their appearance as cystic lesions, and since 12 of the cases have been previously reported, no reproductions (except of Case 12) are submitted. Cases 1 through 7 were reported by Bradford, Mahon, and Grow, and 8 through 12 by Bates and Leaver (3). Cases 13 through 15 have not been previously published.

In addition to the 15 pericardial celomic cysts, several other cases of anterior mediastinal lesions were reviewed in an attempt to find similarities or differences which would help in evaluating the radiographic changes. Several of these are briefly summarized below, and certain features are

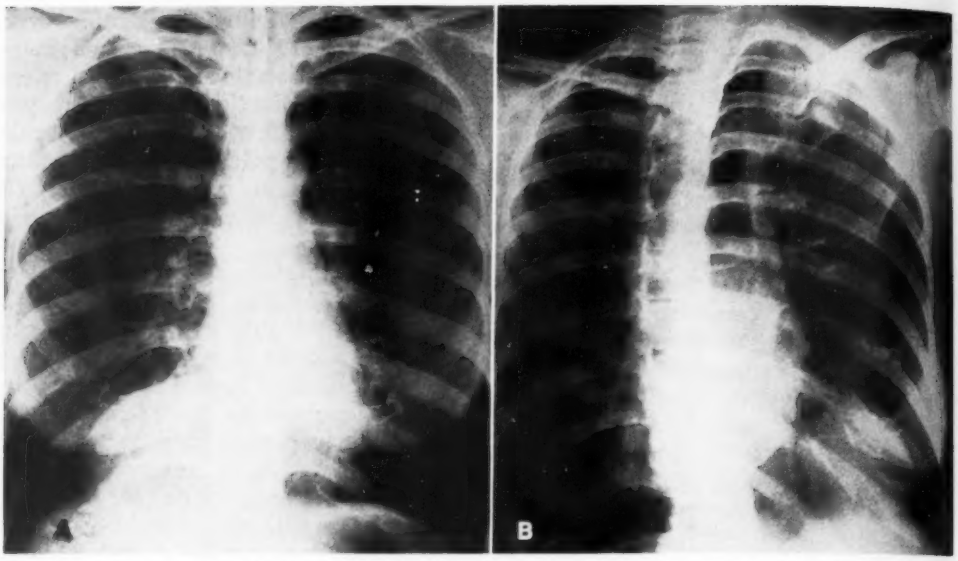

Fig. 1. Case 12: Pericardial celomic cyst. Note angle of demarcation between cyst and pericardium demonstrated in eccentric view.

noted which will be discussed in conjunction with the cases in the table.

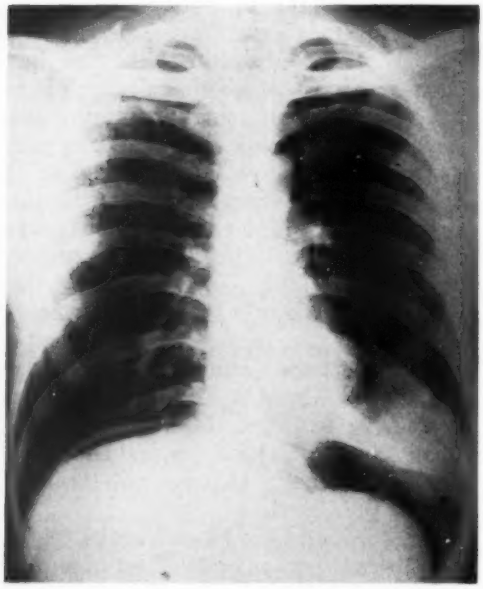

Fig. 2. Case 16: Bronchial cyst. This was previously reported as a pericardial celomic cyst, but microscopic study showed a lining of ciliated epithelium. Note angle of demarcation, which indicates that cyst is not incorporated with the pericardium.

CASE 16: R. R. D. F., male, age 31 years. This was case 9 in the series of Bradford, Mahon, and Grow, and was classified as pericardial celomic cyst. It proved to be lined by ciliated epithelium and was therefore reclassified as a bronchial cyst. The patient had objective symptoms related to the gastrointestinal tract. An earlier chest film was negative. The lesion appeared separate from the cardiac shadow and lobulated. *Diagnosis:* Bronchial cyst.

CASE 17: C. J. B., female, age 3 years, had objective symptoms in the form of long-standing generalized illness accompanied by right pleural effusion. Density in the right cardiophrenic sulcus was felt to represent a localized empyema, and thoracotomy was advised. At surgery, a thin-walled cyst was found containing clear fluid. The cyst was adherent to the pericardium and diaphragm but grossly suggested a pericardial celomic cyst. *Pathologic diagnosis:* Lymphangiomatous cyst.

CASE 18: M. E. W., male, age 37 years, had no objective symptoms. Serial annual chest films, originally reported negative, were reviewed and disclosed an increasing enlargement of the heart to the left in the preceding two or three years. Vague symptoms related to the cardiorespiratory system were elicited after hospitalization. Physical examination and laboratory studies were all normal except for a persistent hypertension of 150 to 180 mm. Hg systolic and 100 to 110 mm. Hg diastolic. This disappeared following surgery. A film of the chest showed a bulge at the left cardiac

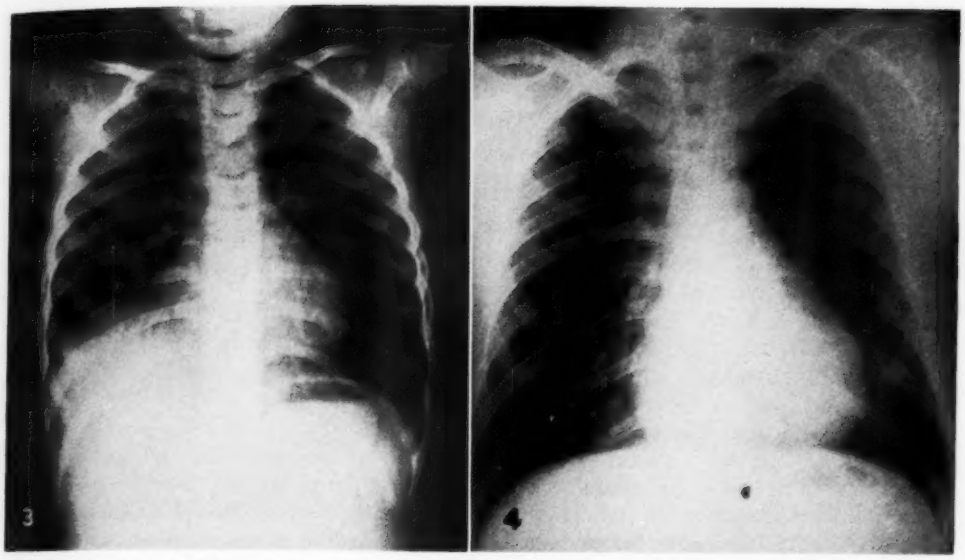

Fig. 3. Case 17: Lymphangiomatous cyst. Lesion developed in presence of pleural effusion.
Fig. 4. Case 18: Lymphangiomatous cyst. Relative lack of adhesions and gross unilocularity suggested pericardial celomic cyst, but diagnosis was established on microscopic examination.

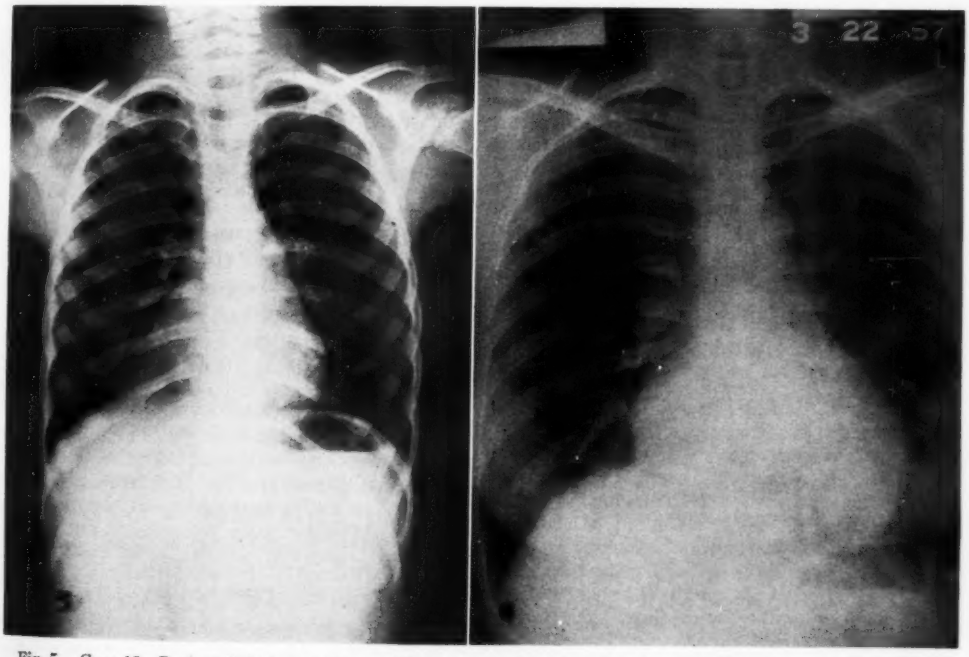

Fig. 5. Case 19: Pericardial diverticulum. The radiographic characteristics are those of pericardial celomic cyst, but at surgery a definite connection to the pericardial cavity was demonstrated.
Fig. 6. Case 20: Localized pericarditis. The mass could not be demarcated from the pericardium in any projection. Correct preoperative diagnosis.

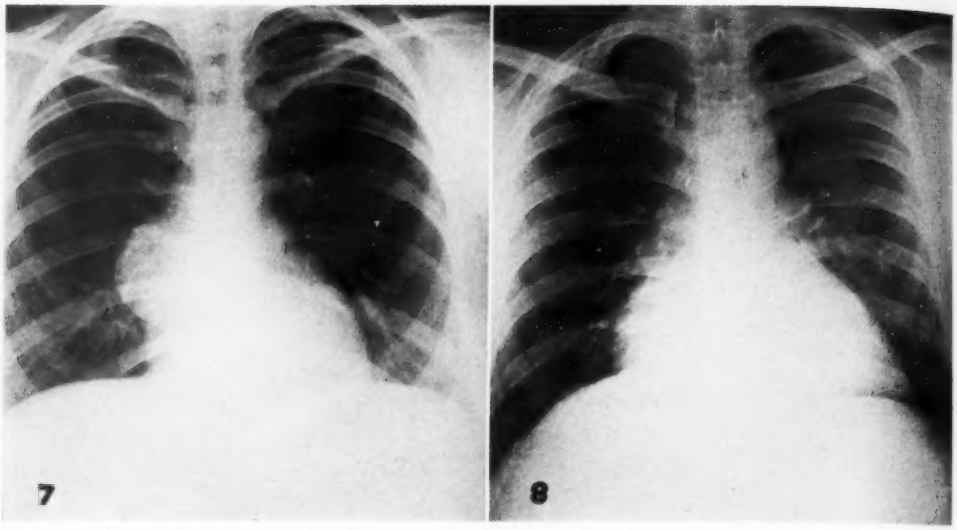

Fig. 7. Case 21: Degenerating benign cyst, type undetermined. The radiographic appearance is similar to cases of pericardial celomic cyst of the upper mediastinum, but on gross and microscopic examination no characteristics of such a lesion were found.

Fig. 8. Case 22: Pericardial fat pad. The mass could not be demarcated from the pericardium in any projection. Correct preoperative diagnosis.

border with margins merging with the heart shadow and no distinct line of separation. At thoracotomy, a fairly large, thin-walled cyst was found which grossly appeared to be a pericardial celomic cyst. Microscopic examination, however, showed evidence of multilocularity plus other elements which warranted a pathologic diagnosis of lymphangiomatous cyst. *Diagnosis:* Lymphangiomatous cyst.

CASE 19: K. L. R., female, age 5 years, had no objective symptoms. There had been no previous x-ray examination. A well circumscribed density was demonstrated adjacent to but apparently separate from the right cardiac border. At thoracotomy, a diverticulum of the pericardium was found, with a thin-necked attachment. *Diagnosis:* Pericardial diverticulum.

CASE 20: E. F., female, age 48, with no objective symptoms, was admitted with a transfer diagnosis of pericardial celomic cyst. A previous chest film (1953) showed a mass in the right cardiophrenic sulcus. This was not seen on a film in 1955 but was again present on films obtained in 1957. All findings were noncontributory. Angiocardiography showed that the mass projected beyond the confines of the right atrium and could be either in the wall of the atrium or in the pericardium. The margins blended with the cardiac shadow without a sharp angle of demarcation. At thoracotomy, the lesion was found to be a localized pericarditis. *Diagnosis:* Localized pericarditis.

CASE 21: I. O. S., female, age 24 years, had mild dyspnea on exertion for one month. A prior chest film had been negative. A well circumscribed mass, projecting into the right midlung field, appeared separate from the cardiac shadow, but on fluoroscopy seemed to be attached at the junction of the right atrium and right ventricle. There was nothing in the gross or microscopic appearance to suggest pericardial celomic cyst. *Pathologic diagnosis:* Cyst, degenerating, benign, type undetermined.

This case is included because of its resemblance to several of the cases in the upper mediastinum reported by Lillie, McDonald and Clagett from the Mayo Clinic.

CASE 22: E. W. P., male, age 25 years, had no objective symptoms. Serial films over several years showed a gradual enlargement of the right lower heart border, with no increase in the anteroposterior cardiac diameter. This localized increase in the heart shadow merged with the remainder of the heart, with no evidence of an angle of demarcation. The radiographic diagnosis was pericardial fat pad. Thoracotomy was advised for actuarial reasons. *Diagnosis:* Pericardial fat pad.

DISCUSSION

Of the 15 cases of pericardial celomic cyst, 4 were in females and 11 in males. This is not significant, however, since the population from which these cases were drawn is predominantly male. The pre-

ponderance of right-sided lesions (ratio 4 to 1) is probably on an embryologic basis.

In all of the 15 cases of pericardial celomic cyst, and in some of the other cases as well, there was noted evidence of demarcation of the lesion from the cardiac shadow. In those instances in which the density of the cyst merges with the heart shadow, eccentric views may be necessary to demonstrate this, as in Case 12. Attention should be paid to the margins of the lesion. If there is a fairly sharp angle at the border of the area of density where it merges with the heart, then the mass probably is separate from the heart even though it lies immediately adjacent to it. If this acute angle does not exist, then the lesion is probably intimately incorporated with or lies within the pericardium. This sign is not pathognomonic of pericardial celomic cyst, but only signifies that the lesion is separate from the pericardium. If it cannot be demonstrated, the diagnosis of pericardial celomic cyst should be viewed with suspicion. The demarcation sign has proved of value in the differential diagnosis of localized pericarditis and pericardial fat pad (Cases 20 and 22). This was true in Case 22 even though there appeared to be a change in configuration of the right-sided density with change in position of the patient.

This change in contour has been suggested as a diagnostic point, and Lam (11) felt that alteration in size and shape of a lesion on inspiration and expiration might point to a diagnosis of pericardial celomic cyst. This view again was based on Lambert's original premise of unilocularity. It appears that such a change would actually indicate nothing more than a large cyst of any etiology. Variation in contour will be governed by the size of the cyst, the tension of the fluid contents, and the relationship to surrounding structures. In Cases 4 and 5, the typical contour associated with cysts was not apparent radiographically, but when the chest was opened and the lesions freed from the pressure of their surrounding structures, they resumed their normal spherical shape.

The 3 to 2 ratio of patients with no objective symptoms corresponds to the general experience. In connection with this, the fact that 12 of the 15 patients had either prior negative chest films in their files or negative reports in their records raises some rather interesting speculation.

Lambert's theory as to the etiology of these cystic lesions, and Lillie, McDonald and Clagett's expansion of this theory, explain why they can be present but do not account for the time of their appearance or the mechanism by which they are produced. Three patients had a history compatible with current or recent respiratory tract infection, and 1 had a history of injury while boxing. It is postulated that the potential for development of pericardial celomic cyst is as explained by Lambert's theory, but that the actual trigger mechanism must be some form of injury, either in the form of inflammatory disease or actual trauma. It is further postulated that in those patients who were asymptomatic, the injury was not of a sufficient degree to have been incapacitating or to have been remembered. This does not preclude the fact that the cysts themselves may be responsible for some of the symptoms. In most cases, however, symptoms do not seem to develop until the cysts become large enough to produce their effects by pressure or by virtue of their location. In several patients vague complaints developed after the cysts were discovered in the course of routine examination, but such cases are almost impossible of evaluation.

In the same vein, it is felt that the adhesions present in Case 3, the multilocularity in Cases 8 and 13, and the atypical appearance of the lining of the cyst in Case 13, were all probably the result of inflammatory reaction. This result does not apply only to pericardial celomic cysts. Lymphangiomatous cysts, as Cases 17 and 18, show changes which may be explained on an inflammatory basis. The lesion in Case 17 was a small cyst which developed in the presence of a pleural effusion, so that the presence of adhesions is of no conse-

quence in the differential diagnosis. In Case 18, the cyst was quite large and grossly appeared to be unilocular. It is thought that the large chamber of the cyst developed at the expense of the remainder of the elements which were manifested by microscopic evidence of multilocularity in the cyst wall. This cyst grew to such a size that it was free of adhesions over a greater portion of its surface, and it seems reasonable to assume that the extent and direction of growth of a cyst will govern its relationship to its blood supply and to surrounding structures.

The pericardial diverticulum in the child, Case 19, had the radiographic appearance of a pericardial celomic cyst, and microscopically the wall of the diverticulum contained the same elements, but grossly there was no question as to the nature of the lesion. Since no pericardial celomic cysts were found in children, this gives rise to the thought that a different mechanism may be involved in the formation of pericardial diverticula, or that they may be formed in more than one manner.

CONCLUSIONS

1. The criteria for the diagnosis of pericardial celomic cyst should include a thin cyst wall, clear fluid contents, and a lining of flattened cells which have the appearance of endothelium or mesothelium, with absence in the wall of any of the elements which would indicate lymphangiomatous or other etiology. To these should probably be added an awareness that the cyst wall and its contents may be altered by inflammatory reaction in the adjacent tissues.

2. The differential diagnosis of pericardial celomic and lymphangiomatous cysts on the basis of locularity is not valid in the face of demonstrated multilocular pericardial celomic cysts and grossly unilocular lymphangiomatous cysts. Therefore, the tapping of cysts for contrast study to establish locularity is not warranted.

3. There appears to be a trigger mechanism which accounts for the time of appearance of these lesions, which can also explain the presence of adhesions, multilocularity, and variations in the cellular lining.

4. A sharp angle of demarcation between an anterior mediastinal lesion and the cardiac shadow, which may require eccentric views for demonstration, indicates that the lesion is not incorporated into or within the pericardium.

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SUMMARIO IN INTERLINGUA

Cyste Coelomic Pericardial. Un Re-Evalutation

Le autores presenta un revista de 15 provate casos de cyste coelomic pericardial e un numero de altere lesiones antero-mediastinal que require differentiation. Le sequente conclusiones esseva obtenite.

Le criterios pro le diagnose de cyste coelomic pericardial debe includer un tenue pariete del cyste, un contento de fluido clar, e un revestimento interior de cellulas applattite que ha le apparentia de endo- o mesothelio, con le absentia—in le pariete—de omne elemento que indicarea un etiologia lymphangiomatose o altere. Il debe esser addite, probabilemente, que le pariete del cyste e su contento pote esser alterate per un reaction inflammatori in le histos adjacente.

Le diagnose differential de cystes pericardial coelomic e lymphangiomatose super le base de lor localitate non es valide, viste le demonstrate occurrentia multilocular de cystes coelomic pericardial e le unilocularitate grossier de cystes lymphangiomatose. Per consequente, le paracentese de cystes pro un studio de contrasto visante a establir lor localitate non es justificate.

Il pare exister un mechanismo precipitatori que explica le tempore del declaration de iste lesiones e que etiam explica le presentia de adhesiones, de multilocularitate, e de variationes in le revestimento cellular interior.

Un angulo acute de demarcation inter un lesion anterior e le umbra cardiac (requirente possibilemente vistas eccentric pro su demonstration) indica que le lesion non es incorporate in le pericardio e non se trova intra illo.

Peptic Ulcers in Rheumatoid Patients Receiving Corticosteroid Therapy[1]

ROBERT H. FREIBERGER, M.D., WILLIAM H. KAMMERER, M.D., and ABRAHAM L. RIVELIS, M.D.

THIS PAPER represents a portion of a clinical and experimental study (13) to determine the frequency with which peptic ulcers occur in patients with rheumatoid arthritis under treatment with various corticosteroid drugs and to investigate the effect of corticosteroids on gastric secretions. The present report is concerned only with the incidence of ulcers, their distribution, location, and roentgen appearance.

Shortly after the introduction of corticosteroids for clinical use in 1950, reports began to appear on the increased occurrence of peptic ulcers in patients treated by these substances. Howell and Ragen (6) reported 18 ulcers in 68 patients receiving cortisone for five to thirty months. Other investigators placed the incidence anywhere from 5 per cent to as high as 37 per cent (7–10). Henderson (4) found that only 5.3 per cent of 1,440 patients treated with cortisone had ulcers. In another series, of 446 cases analyzed by the American Rheumatism Association (5), the figure was 6.6 per cent, which is approximately the incidence of peptic ulcers in the "normal" population. Sandweiss (3) experimented on Mann-Williamson dogs, administering corticotropin and cortisone in dosages comparable to those used in man and observed no peptic ulcer formation in the treated group. Whether there is a specific alteration in the composition of gastric secretions, a lower tissue resistance to the action of gastric juice, or other factors responsible for an increase in gastric ulcers has not been definitely determined.

CLINICAL STUDY

Over a period of twelve months, x-ray examination of the upper gastrointestinal tract was obtained in practically all of our patients with rheumatoid arthritis who had been maintained on corticosteroid therapy for periods of six months or more. These patients, numbering 114, were about equally divided between those attending the arthritis clinic of the Hospital for Special Surgery and private patients of one of the authors (W. H. K.). Thirty-five of the total, or 31 per cent, had peptic ulcers. Of a small control series of 33 patients with rheumatoid arthritis who were not receiving corticosteroid therapy, 3, or 9 per cent, had ulcers.

Every effort was made to examine all the patients treated with corticosteroids, and gastrointestinal symptoms were not used as criteria for selection. Of the ulcers found, 4 represented reactivation of previously known ulcers and 31 were new.

Ulcers developed in 6 of 22 men and in 29 of 95 women, a relatively equal incidence for the sexes, which is in sharp contrast to the far greater frequency of spontaneous peptic ulcers in males. Ulcers occurred as frequently in patients whose arthritis had existed less than ten years as in those with a longer history. A greater ratio of peptic ulcer was found in patients having moderately severe to severe rheumatoid arthritis (classified according to American Rheumatism Association criteria) than in those with milder disease. In patients who had had over six months of corticosteroid therapy, the length of treatment did not appear to be of significance.

Doses of corticosteroids were classified as small, moderate, and large. With prednisone as an example, a small dose consisted of 2.5 to 7.5 mg., moderate 10 to 15 mg.,

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[1] From the Rheumatic Disease Section and Department of Radiology, Hospital for Special Surgery and the Department of Medicine, Cornell Medical School, New York, N. Y. Accepted for publication in March 1958.

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The prednisone and prednisolone (Meticorten and Meticortelone) used in this study were generously supplied by Schering Corporation. Triamcinolone was made available by the Lederle Company.

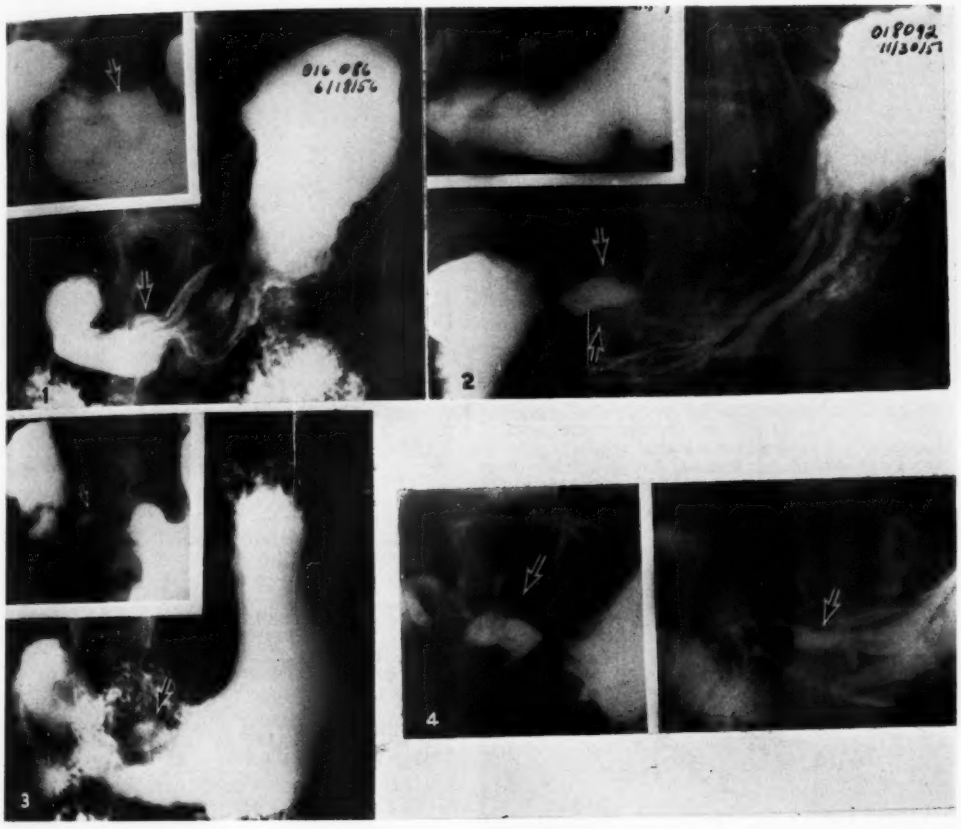

Fig. 1. R. S., 66-year-old female; seven years of corticosteroid therapy. A peristaltic wave is seen adjacent to a large shallow lesser-curvature antral ulcer. Rugal folds radiate from the ulcer (see insert).

Fig. 2. E. S., 71-year-old female, sister of R. S. (Fig. 1); six and a half years of steroid therapy. A large, shallow lesser-curvature antral ulcer is present. The patient is now (December 1957) hospitalized, in serious condition with acute epigastric distress probably due to perforation of the ulcer.

Fig. 3. N. S., 56-year-old female; seven years of corticosteroid therapy. Smooth, shallow, flexible lesser-curvature antral ulcer.

Fig. 4. S. K., 58-year-old female; three years of corticosteroid therapy. The crater is irregular, the stomach wall is stiff and contracted. Carcinoma was suspected at the first examination (left). Two weeks later (right) the crater is smaller, with rugal folds radiating from it.

and large above 15 mg. daily. Only 5 patients received more than 15 mg. per day, and 2 ulcers were seen in this group. The ulcer incidence was greater in the moderate-dose group—26 of 58 patients—than in the small-dose group—1 of 21 patients.

Symptoms Referable to the Gastrointestinal Tract: Ten patients had no symptoms. Of the remaining 25, many had no abdominal pain and symptoms were minimal; they were elicited only upon close questioning and would not have been brought to the physician's attention voluntarily. Many patients mentioned "sour stomach" or eructations, but the same complaints could be elicited from those treated only by salicylates (12). Despite the lack of symptoms, the usual complications of peptic ulcer were encountered in this group. Four patients had gross bleeding manifested by either hematemesis or melena; 3 had stools which were persistently positive for occult blood. Six patients had an episode of acute abdominal distress, and 3 of these were operated upon. In 2 instances acute perforation of an ulcer had occurred, one

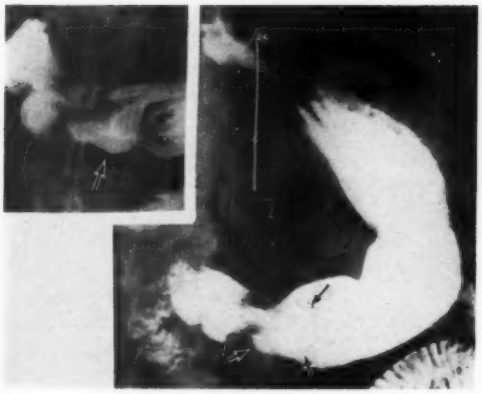

Fig. 5. L. C., 71-year-old female; three years of corticosteroid therapy. A large, shallow greater-curvature antral ulcer is present, with very flexible base as seen fluoroscopically. Rugal folds radiate from the crater.

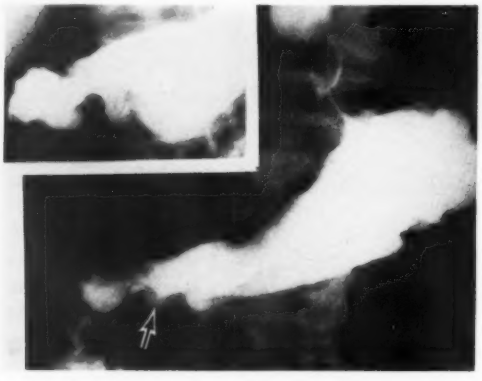

Fig. 6. M. H., 47-year-old female; seven years of corticosteroid therapy. Note the smoothly thickened gastric wall at the edge of the crater. This is also seen on the other illustrations and represents inflammatory edema. This ulcer was healed at the time of the patient's death in January 1957.

gastric and one duodenal; in the third case a diverticulum of the colon had ruptured. Three patients who had an "acute abdomen" were treated conservatively and were not subjected to surgery. One of these, E. S. (Fig. 2), is now hospitalized elsewhere, in serious condition with acute abdominal distress.

Location and Appearance of the Ulcers: The location of the ulcers was unusual. Only 5 of 35 ulcers were in the duodenum, a ratio of 1 duodenal to 6 gastric ulcers. This is practically the reverse of the ratio

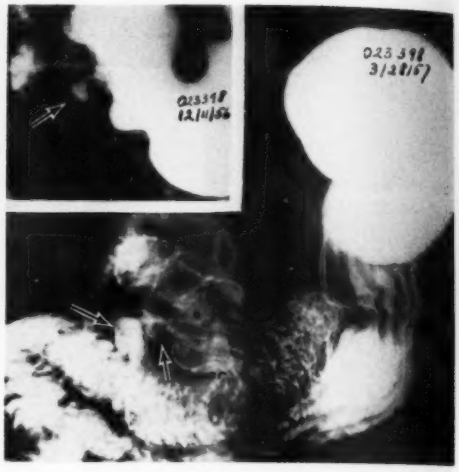

Fig. 7. B. B., 50-year-old female; two and a half years of corticosteroid therapy. Deep greater-curvature antral ulcer with flexible walls and base as noted on fluoroscopy.

in the idiopathic ulcer group in the general population. The roentgen features of the duodenal ulcers were not out of the ordinary. The gastric ulcers had an unusual distribution within the stomach, all but 2 lying in the antrum, 8 at the greater and 20 at the lesser curvature. Most of the ulcers presented a distinctive appearance both on fluoroscopy and films. As can be seen on the illustrations, a large number were shallow, with the diameter of the crater considerably greater than its depth, and surrounded by a zone of smoothly thickened stomach wall, which we attribute to inflammatory edema. In many cases rugal folds could be seen radiating from the ulcer crater. A striking finding was the flexibility of the gastric wall at the base and in the immediate vicinity of the crater. Barium could be emptied from the crater with only slight pressure, and in many cases peristaltic waves passed the area of the ulcer with practically no deformity. Neither pylorospasm nor duodenal irritability was found in any of these patients. Because of the absence of rigidity of the stomach wall and the shallowness of the crater, detection of the ulcer was often difficult. One patient, I. L., recently had a partial gastrectomy because

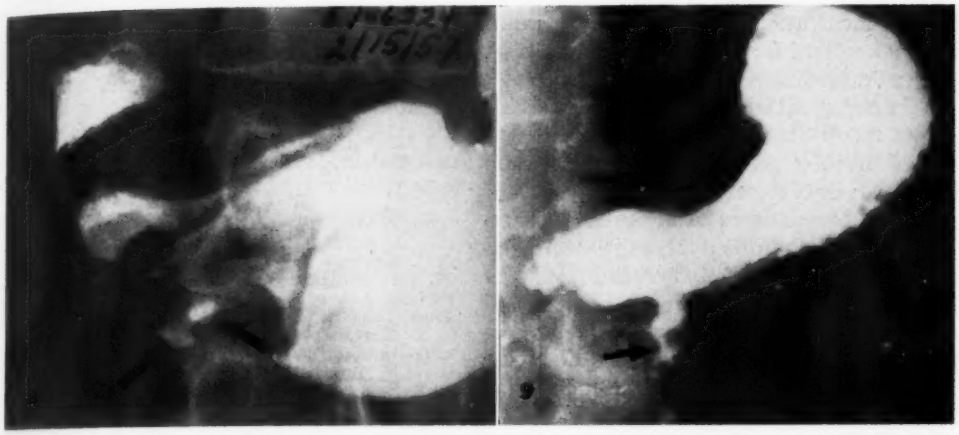

Fig. 8. T. G., 44-year-old female; seven years of corticosteroid therapy. Greater-curvature gastric ulcer with two craters. The ulcer base was flexible. No pylorospasm was found in this or any other corticosteroid ulcer patient.

Fig. 9. A. B., 11-year-old female; four years of corticosteroid therapy for juvenile rheumatoid arthritis. Deep, penetrating greater-curvature ulcer. First symptom severe hemorrhage.

of persistence of a large, shallow lesser-curvature ulcer in the body of the stomach without evidence of healing in three months. The surgeon reported that the stomach was adherent for a short distance to the pancreas at the base of the ulcer but remained so flexible that he could not feel the ulcer through the gastric wall.

In this series of 114 patients no carcinoma of the stomach has been encountered. While many features of benignity, such as radiating rugal folds, penetration beyond the inner surface of the stomach, and unusual flexibility of the stomach wall were demonstrated, it is acknowledged that a definite differentiation between benign and malignant even in these cases is not always possible. Two patients, one shown in Fig. 4, had ulcer craters with irregular margins and rigidity of the stomach wall at the ulcer site, strongly suggesting carcinoma. In both instances, examination after a short interval showed definite diminution in the size of the ulcer crater and radiation of rugal folds during the period of healing. A few of our patients who had gastric ulcers had complete histamine achlorhydria.

ROENTGEN EXAMINATION

Whenever possible, we obtained four to eight spot-films of the antrum with varying pressure, and air-contrast films for the rugal pattern of the stomach, with the patient supine or in the left posterior oblique position. Routine examination included various oblique projections in the erect, supine, and prone positions. Because many of these patients were severely crippled by their arthritis, examinations could sometimes be performed in only the supine and supine oblique positions. Most who were in this category were examined more than once to be certain that a complete survey of the stomach and duodenum had been made.

MANAGEMENT OF THE ULCER PATIENT

It is not our purpose in this report to describe the management of the patient in any detail. In most cases corticosteroid therapy was discontinued, the patients were placed on an ulcer regime, and in most of them the ulcers healed satisfactorily. In some cases healing of the ulcer was extremely slow. Two patients received x-ray therapy to the stomach, which resulted in temporary histamine achlorhydria. In both these cases the ulcers became smaller and were considered healed a few weeks after completion of irradiation. The ulcers recurred, however, after return to

steroid medication, although only a minimal amount of free hydrochloric acid was present after histamine stimulation.

Whenever withdrawal of corticosteroids would mean that a patient would be converted from a state of relative self-sufficiency to one of dependence on a wheel chair or a bed, the dangers of bleeding and perforation on continued therapy were explained. These patients invariably elected to remain on corticosteroid therapy and take their chances with possible complications. In those who were maintained on corticosteroids, the dose was reduced if at all possible, and an ulcer regime, including both diet and anticholinergic drugs, was prescribed. Though some ulcers healed while steroid therapy was continued, others did not during the period of observation, two years in one instance.

SUMMARY

An examination of the upper gastrointestinal tract in 114 patients receiving corticosteroid therapy for rheumatoid arthritis revealed peptic ulcers in 35, or 31 per cent. The incidence of ulcers appeared proportionately related to the dose of corticosteroids and to the severity of the arthritis. Of the ulcers, 30 were in the stomach and 5 in the duodenum. Of the gastric ulcers the great majority were in the antrum, 8 at the greater curvature. Ten of the ulcer patients had serious complications, both severe bleeding and perforation. Not only the antral location but also the roentgen appearance of the ulcer was in many cases unusual. Particularly noteworthy was the flexibility of the stomach wall beneath and adjacent to the ulcer crater. The atypical appearance of a large number of these ulcers and the fact that the routine positions normally used in gastrointestinal examinations cannot be assumed by severely crippled patients can make detection of the lesions difficult.

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SUMMARIO IN INTERLINGUA

Ulceres Peptic In Patientes Rheumatoide Sub Tractamento Corticosteroide

Le examine del vias supero-gastrointestinal de 114 patientes sub tractamento corticosteroide pro arthritis rheumatoide revelava ulceres peptic in 35. Iste incidentia de 31 pro cento esseva a comparar con un incidentia de 9 pro cento in un micre numero de patientes de arthritis rheumatoide non sub tractamento corticosteroide. Il pareva

que le incidentia de ulceres esseva relationate proportionalmente al dosage de corticosteroide e al severitate del arthritis. Trenta del ulceres esseva in le stomacho, 5 in le duodeno. Inter le ulceres del stomacho, le majoritate esseva in le antro, 8 al curvatura major. Dece del patientes con ulcere habeva serie complicationes, incluse sanguination sever e perforation.

Non solmente le location antral sed etiam le apparentia roentgenographic del ulcere esseva inusual in multes del casos. Particularmente notabile esseva le flexibilitate del pariete stomachal infra le crater del ulcere e adjacente a illo. Le apparentia peculiar de un numero de iste ulceres e le facto que le positiones routinari que es normalmente usate in examines gastrointestinal non pote esser prendite per severmente deformate patientes resulta a vices in difficultates in deteger iste lesiones.

Some Anatomical and Roentgenologic Considerations with Respect to the Lumbosacral Spine

With Special Reference to Retrodisplacement[1]

ABRAHAM MELAMED, M.D.

THE ARTICULATIONS between the lumbar vertebrae and sacrum are important anatomical and functional units in the human body. Unfortunately our knowledge of the normal and abnormal anatomy of these structures is deficient in many respects, often leading to erroneous conclusions in the evaluation of symptoms referable to the lower back.

The study to be reported here was undertaken primarily to determine the pathogenesis of retrodisplacement of lumbar vertebrae. The bony components of the articulations between these vertebrae and the sacrum were studied from the anatomical and radiographic standpoints. Dried human bone specimens were used.

ARTICULAR FACETS

Many authors claim that the lumbar articular facets incline downward and posteriorly. This implies, of course, that when intervertebral disk narrowing occurs the cephalad vertebra is forced downward and backward. This proposition has been advanced in explanation of posterior displacement of lumbar vertebrae (1). We know from experience, however, that thinning of the lumbar disk is a frequent x-ray finding but posterior displacement is not. Scott (2) and others fail to mention posterior displacement of the lumbar vertebrae as a sequela or associated finding in cases of subluxation of the facets. This apparent paradox pointed to the necessity for anatomical studies of the articular facet surfaces.

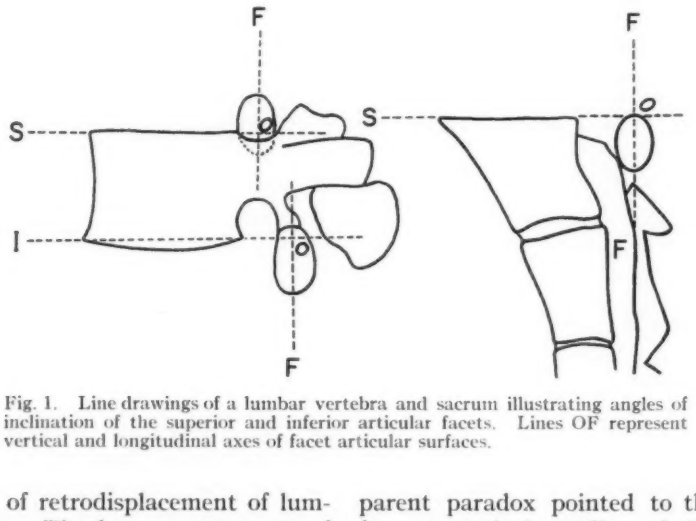


Fig. 1. Line drawings of a lumbar vertebra and sacrum illustrating angles of inclination of the superior and inferior articular facets. Lines OF represent vertical and longitudinal axes of facet articular surfaces.

Thirty-four articulated human spine specimens from the anatomical museum of Marquette University Medical School and the General Biological Supply House of Chicago were examined. The Marquette University dried specimens (9) were representative of the Milwaukee population, while the remainder were specimens from India. First, the angles

[1] From the Department of Radiology, Evangelical Deaconess Hospital, Milwaukee, Wisc. Accepted for publication in March 1958.

of inclination of the facet surfaces were measured. A ruler was placed against the facet surface along its vertical axis while another ruler was placed on the corresponding horizontal vertebral body surface. The lines represented by the rulers form angles of inclination, SOF and IOF, of the superior and inferior articular facet surfaces, respectively (Fig. 1). By definition, then, acute angles SOF and obtuse angles IOF are equivalent to posterior inclination of the articular facet surfaces.

Five of the 9 Marquette University specimens showed vertical superior and inferior facets, *i.e.*, angles SOF and IOF were 90°. A few of the lumbar facets of the remaining 4 spine specimens showed very slight (a few degrees) or insignificant posterior inclination. In none of the 9 spines was it possible to produce posterior displacement of any of the lumbar vertebrae by narrowing the interspace and/or by subluxating the facets (Fig. 2).

The Indian spines exhibited similar characteristics. In only one sacrum containing symmetrical facets were the angles indicative of very slight (a few degrees) posterior inclination. Abolition of the intervertebral spaces in these specimens also failed to produce malalignment or retrodisplacement of the vertebrae.

To test further the constancy of these observations, 30 sacra, representing material obtained from various countries, were examined. Although there was great variation as to size, the long facet planes were, to all intents and purposes, vertical in relation to the horizontal plane of the top of the sacra.

A few other salient anatomical features of the articular facet surfaces are worth mentioning. Asymmetry and other structural variations of the articular facets occur with greater frequency in the lower than in the upper lumbar region. Most of the upper lumbar facet surfaces lie in the sagittal plane, facing medially and laterally. In the lower lumbar region the facet surfaces lie in the oblique or transverse planes, facing anteriorly and posteriorly. The upper lumbar vertebrae contain more shallow superior and less convex inferior articular facet surfaces than the lower lumbar vertebrae.

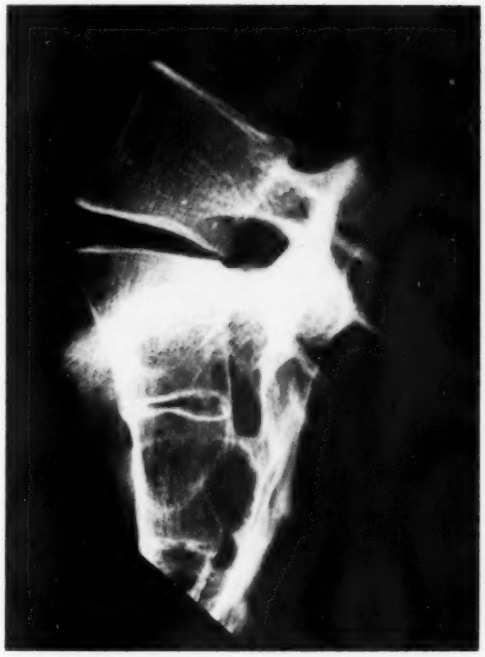
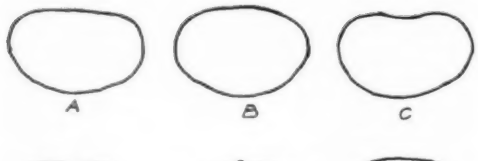


Fig. 2. Lateral roentgenogram of an average dried lumbosacral bone specimen. No retrodisplacement was created by obliterating the posterior portion of the intervertebral space and subluxating articular facets, confirming the fact that lumbar and sacral articular facet surfaces do not incline backward.

In 24 of the 30 separate sacra examined, the facets were symmetrical: 20 pairs were concave; 4 pairs flat. The facet surfaces of the sacra varied from the medial-lateral to the anterior-posterior types.

It was of interest to discover that the bony surfaces of adjacent articular facets do not always "match" or "fit." Facet surfaces are not always purely concave or convex. In one or two instances a concavity or depression was found in the center or peak of the convexity of a facet. It is also interesting to observe that the radii of the convexities and concavities lie in vertical or horizontal planes rather than conforming to the configuration of a hemisphere.

The cartilaginous coverings of the facets were absent in the specimens examined.



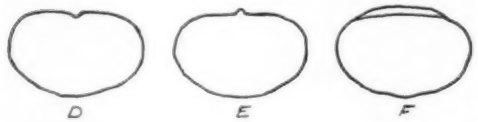


Fig. 3. Various configurations of the superior articular surfaces of the sacrum.

Since these cartilaginous components are approximately of paper thickness, they were disregarded in our considerations. It is assumed they would have no bearing on the gross anatomical relationships involved.

ARTICULAR SURFACES OF VERTEBRAL BODIES

In questions of displacement at the lumbosacral junction the size and shape of the articular surfaces of the vertebral bodies have important roentgenologic implications (3). For this reason, the configurations and measurements of these adjacent articular surfaces were recorded.

As anticipated, we found considerable variation in the configuration of the superior articular surfaces of the dried sacral specimens. These variations are illustrated in Figure 3. The posterior borders of the sacra of the 9 complete spines were concave in 2, straight in 5, convex in 2; 3 were asymmetrical. The adjacent posterior margins of the 5th lumbar vertebral body were concave in 4, convex in 4, notched in 1; asymmetry was noted in 2.

Measurements of the midsagittal diameters of the adjacent articular surfaces of L-5 and the sacrum showed the sacrum to be smaller in 7, larger in 1, same size in 1. The same relationships were noted with regard to the greatest anteroposterior measurements.

The posterior margins of the 25 Indian sacra were convex in 10, straight in 8, concave in 7. Only one asymmetrical contour was seen. The midsagittal diameters of the adjacent articular surfaces were as follows: sacrum smaller than L-5 in 20, sacrum larger in 2, sacrum same size in 3. The greatest anteroposterior measurements were as follows: sacrum smaller than L-5 in 18; larger in 3; same size in 4.

COMMENT

Normal alignment of vertebrae is maintained by intact bony, cartilaginous, and soft tissues. Disturbances in any one of these components may eventually result in malalignment. In this study the primary aim was to ascertain what bony factors and, by manipulation and implication, what soft-tissue factors, as well, are responsible for true and pseudo-retrodisplacement of the lumbar vertebrae. The anatomical data obtained have important roentgen implications.

Our studies failed to confirm the existence of any or significant posterior inclination of the lumbar articular facets. We found no evidence to substantiate the oft repeated theory that posterior inclination of the lumbar articular facets is the cause of retrodisplacement. In none of the dried specimens examined were we able to produce retrodisplacement of lumbar vertebrae by narrowing the intervening space and/or by subluxating the articular facets (Fig. 2). This evidence proves that other factors enter into the causation of retrodisplacement.

In the intact spine with average lordotic curvature and lumbosacral angulation, the center of gravity of the body passes through the third lumbar vertebral body. If for any reason this is shifted backward, one prerequisite for the development of

retrodisplacement is fulfilled. This can eventually supervene if the integrity of the intervertebral disks, apophyseal joint capsules, and spinal ligaments is disturbed or compromised by the shearing force of gravity. This explains the greater frequency of retrodisplacement in the upper lumbar region, where the changes in the center of gravity occur and are reflected earlier. Retrodisplacement can occur at the lumbosacral junction, but the degree of shift of the center of gravity is necessarily greater or more advanced. In such instances we usually find a kyphotic rather than a lordotic curve. Under these conditions it is not necessary for the fifth lumbar vertebra to travel "uphill," as Willis (4) contends, but rather "downhill"; the top of the sacrum is now sloped downward and backward.

In most instances the x-ray diagnosis of true retrodisplacement is not difficult if a true lateral projection is available. The lumbosacral junction, however, is an exception. Many uncertainties arise at this level. There are several reasons for this (3), the main one being the difference in the anteroposterior measurements or diameters of the adjacent articular surfaces of L-5 and the sacrum. The anteroposterior diameter of the fifth lumbar vertebral body is greater than that of the sacrum in 70 to 80 per cent of all patients. This gives rise to an apparent overlap of the posterior margins. Sometimes simple flaring of the posterolateral margins of L-5 is responsible for this overlap.

Overlapping of the posterior articular margins at the lumbosacral junction on lateral radiographic projections can be minimized by use of as large a target-to-film distance as is practicable. Shorter distance technics create apparent malalignments in many patients (3). Extreme caution should be exercised in the examination or evaluation of lateral projections of the lumbosacral spine. We have often found it advantageous to follow the curve formed by the anterior borders of the spinal canal rather than to use the articular margins as reference points. This can best be accomplished by viewing and studying lateral views of the entire lumbosacral spine at a greater distance than usual so that the overall alignment can be evaluated. This will serve to resolve most of the problems and questions in the roentgen diagnosis of retrodisplacement, whereas "spotting" on the lumbosacral junction or examining a "spot" view is often misleading. In the average case the line representing the anterior border of the spinal canal will transect the posteroinferior flaring of the fifth lumbar vertebral body. On the other hand, if this smooth line or curve is distorted in any other way, true displacement should be suspected and confirmed by other criteria (3), such as widening of the apophyseal joints where the facets are of the anterior-posterior type or posterior displacement of inferior articular facets of medial-lateral type, "hour-glass" narrowing of intervertebral foramina, alteration of spinal curvature, parallel motion between vertebrae in flexion and extension.

NOTE: Thanks are expressed to Dr. Walter Zeit, Department of Anatomy, Marquette University School of Medicine, and the General Biological Supply House, Chicago, for specimens made available for this study.

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SUMMARIO IN INTERLINGUA

Considerationes Anatomic E Roentgenologic Relative Al Spina Lumbosacral, Con Referentias Particular Al Retrodisplaciamento

Un studio de 34 articulate specimens de spina human non confirmava le existentia de grados significative de dislocation posterior del lumbar faciettas articular, e similemente nulle constatationes esseva facite in supporto del frequentemente repetite theoria que le inclination posterior del lumbar faciettas articular es le causa de retrodisplaciamento. In nulle del desiccate specimens esseva il possibile producer retrodisplaciamento de vertebras lumbar per reducer le spatio intervallari e/o per subluxar le faciettas articular. Per consequente, altere factores debe esser incriminate in le causation de retrodisplaciamento.

In le spina intacte con grados medie de curvatura lordotic e de angulation lumbosacral, le centro de gravitate del corpore se trova super un linea vertical que transseca le tertie corpore vertebral lumbar. Si isto—pro un ration o un altere—es movite in retro, un del preconditiones pro le disveloppamento de retrodisplaciamento es satisfacite. Illo pote evenir in le curso del tempore si le integritate del disco intervertebral, le apophysee capsulas articular, e le ligamentos spinal es disturbate o compromittite per le tension cisorial del fortia de gravitate.

Ben que le roentgeno-diagnose de retrodisplaciamento es usualmente facile a facer si un projection lateral es disponibile, incertitudes pote occurrer al nivello del junction lumbosacral. Grande exactitude debe esser exercite in le evalutation de projectiones lateral de iste region. Le autor ha trovate avantagiose sequer le margines anterior del canal spinal plus tosto que usar le margines articular como punctos de referentia. In le caso typic, iste linea transseca le curva postero-interior del corpore del quinte vertebra lumbar. Si iste linea es distorquite e non lisie, le presentia de displaciamento debe esser suspicite e confirmate per altere criterios.

Radiological Identification of Fibrous Dysplasia of the Jaws[1]

ROBERT S. SHERMAN, M.D., and OSCAR J. GLAUSER, M.D.

FIBROUS DYSPLASIA of the jaws has been noted in a number of reports, but a clear and complete picture of its roentgen appearance in the mandible and maxilla has not emerged. This is because the number of cases studied has usually been small or because the jaw involvement was but a part of the general disease and therefore was not presented in detail. This study of 17 histologically proved cases of fibrous dysplasia of the jaw is undertaken, therefore, to formulate a basis for the roentgen identification of that disease.

In about 50 per cent of all the patients with fibrous dysplasia referred to us for x-ray consultation, jaw involvement has been the presenting or only manifestation of the disease. In addition to the relative frequency with which the jawbones may be the main site of the process, there are other reasons for considering the roentgen diagnosis of fibrous dysplasia of the jaw in a separate category. The differential diagnosis of jaw lesions, because of the presence of dental elements, is more complicated and specialized than that of lesions of other bones of the face. Difficult technical problems are encountered as well. Furthermore, it is through the dentist or oral surgeon that many conditions involving the jaw first come to light. If he is armed with a thorough knowledge of the roentgen diagnosis of all diseases affecting the jaws, the roentgenologist can bring much of value to this area where his abilities have often not been fully utilized.

The roentgen diagnosis of the polyostotic form of fibrous dysplasia is usually easy, and the findings that may be encountered have been thoroughly described in the literature (2, 3, 5, 7, 9, 18). Naturally a thorough knowledge of the appearance of the generalized form of fibrous dysplasia provides the basis for its recognition as a monostotic lesion or one confined principally to the jawbones.

Each of the 17 cases in our series was diagnosed pathologically by a member of the Pathology Department of Memorial Center. In approximately two-thirds this diagnosis was unequivocal. In the remainder the opinion was "consistent with fibrous dysplasia." All doubtful cases were reviewed by Dr. Arthur Allen of the Pathology Department before they were accepted. In a few cases, because the pathological material was somewhat scanty and the diagnosis was not unequivocal, it was only after thorough consideration of the roentgenologic, clinical, and pathologic data that the case was included. Each patient had one or more x-ray studies of the jaw.

It is the prevailing thought of the Department of Pathology that, while closely similar and at times indistinguishable from each other, ossifying fibroma and fibrous dysplasia often present minor distinguishing histological features. Certainly in the greater part of this material the diagnosis was unquestionably fibrous dysplasia. The same was true of the material used previously for a study of the roentgen diagnosis of ossifying fibroma (12). In such closely allied conditions some overlap is bound to have occurred, and re-examination now shows that 2 of the previously reported ossifying fibroma cases better conform to a diagnosis of fibrous dysplasia. In fact, one of these is included in the current series. Supporting the pathologist's point of view that at times there is a recognizable difference between fibrous dysplasia and ossifying fibroma is the fact that radiographically ossifying fibroma in its characteristic form looks quite different from most cases of fibrous dysplasia of the jaw.

Fifteen of the 17 cases of fibrous dys-

[1] From the Department of X-ray Diagnosis, Memorial Center, New York, N. Y., and the James Ewing Hospital, New York, N. Y. Accepted for publication in April 1958.

plasia were apparently monostotic. One patient had involvement of the maxilla and the zygoma and in the other the mandible and both maxillae were invaded. Unfortunately a skeletal survey was done in only 6 cases; in all these the findings were negative. Neither was there clinical evidence of polyostotic fibrous dysplasia or Albright's syndrome in any of the 17 patients.

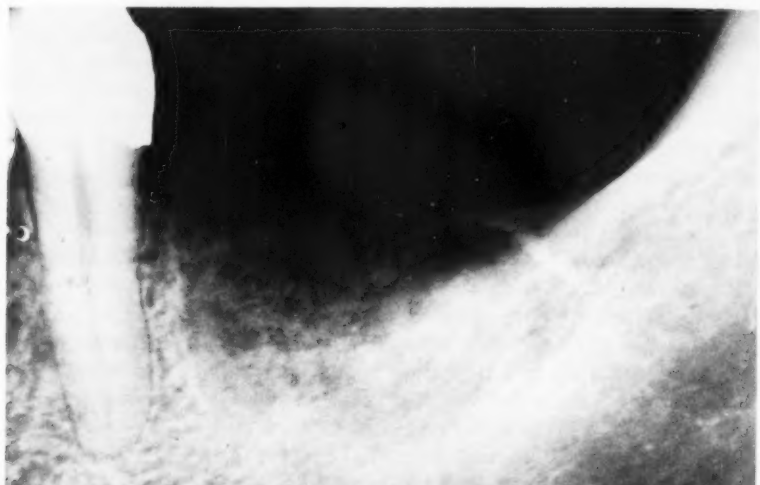

Fig. 1. Smallest of the lesions. A unilocular focus with fine, expanded, intact cortex at alveolus.

Twelve cases of the generalized form of fibrous dysplasia were also reviewed radiographically. Only 1 of these showed definite jaw disease. This was a typical sclerotic lesion in the maxilla quite similar to the dense lesions of monostotic fibrous dysplasia of this bone that are to be described. This case is not included in the present study because the roentgen coverage was not considered sufficiently complete. One other of the 12 polyostotic fibrous dysplasias showed questionable maxillary changes. The relative infrequency of jaw involvement in polyostotic fibrous dysplasia is indicated in this sampling, as well as by the experience of others (8, 10, 17).

Eleven patients were female and 6 were male. The age range was eight to forty-four years, with 9 of the series between eight and fourteen years, 4 between seventeen and twenty-five and 4 between thirty-one and forty-four. In no instance was there any hint of fibrous dysplasia in other members of the family, although often the clinical histories were far from complete in this respect.

The usual complaints were painless swelling with asymmetry of the face and disturbance in the position of the teeth. The duration varied from four days to seventeen years, most cases giving a history of several months to several years. Excision or curettage was performed 14 times, but in 3 instances the lesion was only biopsied. Except for 1 patient with a recurrence after one year, all were apparently clinically free of disease or unchanged after a follow-up of several years or more.

The lesion was located in the mandible in 11 patients, in the maxilla in 5, and in the mandible and maxilla in 1. Five of the cases involving the mandible showed the bulk of the lesion in the body, with slight

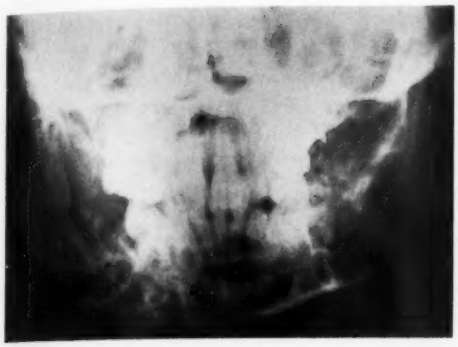

Fig. 2. Multiloculated x-ray type. Same case as that shown in Fig. 5. Probably familial fibrous swelling of the jaws.

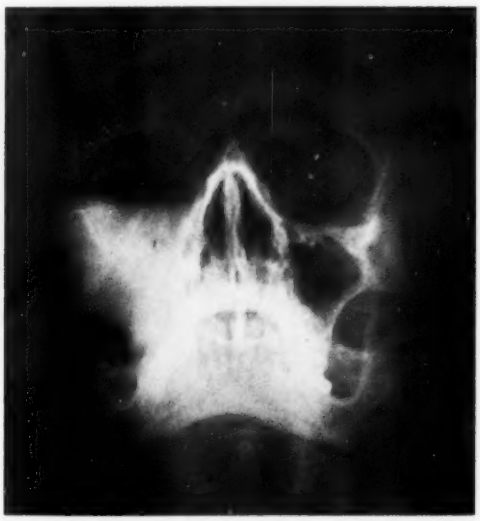

Fig. 3. Typical sclerotic form in maxilla. Note general enlargement of bone and the regular, fine, dense structure.

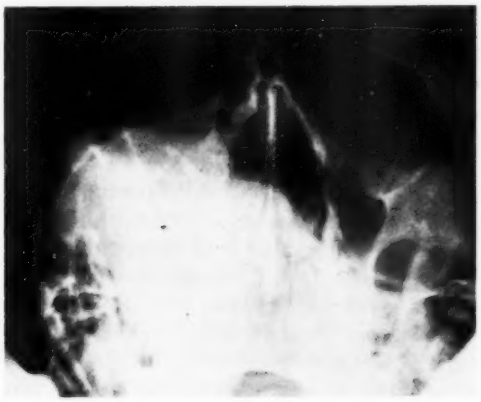

Fig. 4. More extensive sclerotic form.

extension across the symphysis in 2. In 3 of these cases the deposits were located more or less symmetrically within the mandible, but the 2 smallest lesions, which occupied only part of the width of the bone, were definitely eccentric in location, *i.e.*, at the alveolar ridge (Fig. 1). The angle of the mandible was the part involved in 3 instances, with more or less encroachment upon the body and ramus. Twice the symphysis was the predominant site of the disease. Once the ramus and once almost the entire mandible, from one sigmoid notch to the opposite sigmoid notch except for a small skip area at the symphysis, was diseased (Fig. 2).

All 6 cases involving the maxilla showed the pathological process to include almost the whole maxilla, and in 1 of these the disease occurred bilaterally. Two cases spared only a small segment in the upper and medial part of the bone. The 3 dense sclerotic cases obliterated the antrum either partly or completely (Figs. 3 and 4) while the 3 more or less lytic cases showed the antrum to be nearly filled and replaced by disease (Fig. 5).

If we classify the lesions according to size, as small, medium, and large, the diameters being 2.5 cm. or less, 2.5 to 7.5 cm., and more than 7.5 cm. respectively, 2 fall into the small, 11 into the medium, and 4 into the large size group. The smallest mass measured slightly less than $2.5 \times 1 \times 1$ cm., the largest, involving almost the entire mandible, about $17 \times 4 \times 4$ cm. Usually the lesions were oval to spherical in shape, averaging $7.5 \times 5 \times 5$ cm.

In the maxilla the disease almost uniformly followed the anatomical shape of the bone, while enlarging it moderately. One lesion, however, was more or less oval without much relationship to the general contour of the normal bone. The deposits in the mandible were predominantly oval in shape, lying within the bone and causing some expansion. The bulk of most of the

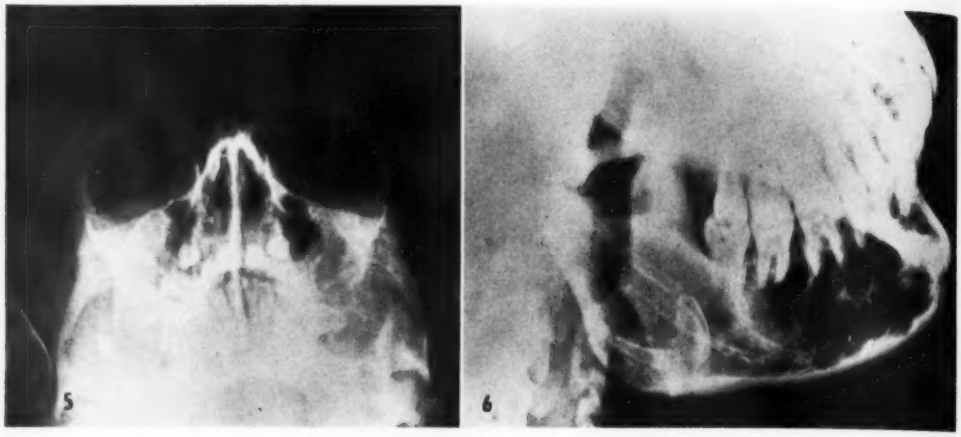

Fig. 5. Multilocular form in both maxillae. Same case as Fig. 2.
Fig. 6. Multilocular x-ray type in mandible.

lesions made a definite determination of the site of origin rather difficult. From the smaller ones, however, the impression was gained that the disease starts within the medullary cavity, either symmetrically or slightly asymmetrically, with uniform growth in all directions.

The 12 lesions in the mandible, while usually lytic, did exhibit at times some slight degree of productive or sclerotic change. In 8, complete or partial loculation with some septa or ridges could be observed. Sometimes the septations were rather dense. Occasionally, however, only delicate calcific striae or strands were present. Most deposits also contained some small flecks or patches of irregular calcification. Four were unilocular without any definite strands, ridging, or septa. In these the sclerosis was rather conspicuous, a slight ground-glass density being a feature in two. Three of the maxillary lesions were extremely sclerotic, with an evenly dense, eburnated, or almost ivory-like appearance. Three were more or less lytic, 2 unilocular with small irregular calcific flecks and slight ground-glass sclerosis, and 1 typically multilocular, with the same pattern also being present in the mandible.

The boundary of the disease process was usually sharp and quite distinct, the medullary border sometimes being outlined by a thin sclerotic strand. In the 3 sclerotic lesions of the maxilla, however, the pathological area shaded into the normal bone without a distinct border. A few of the lytic lesions of the mandible also showed this shading or blending with normal bone at the medullary border, whereas the cortical border was uniformly sharp. In addition, the cortex was very often scalloped, especially in the cases with septation, and thinned and expanded. However, with deposits having conspicuous expansion the cortex was more evenly thinned and egg-shell-like. In only one case—in the maxilla—was there some destruction of the cortex at the lateral wall of the maxillary antrum.

Very careful review did not reveal periosteal reaction of any type. By the same token, no soft-tissue mass outside the border of the lesion could be observed. We were not able to detect any pathological fracture.

As a rule, the tooth displacement was manifested by a slight separation and malposition. In a few instances of mandibular involvement, however, dental malposition was quite pronounced. The lamina dura was lost in about half the cases when the tooth was in contact with the area of fibrous dysplasia (Fig. 6).

In 2 patients an unerupted tooth was seen partly within the lesion. The appearance, however, was completely different from a follicular or dentigerous cyst because the tooth was normally formed and showed a normal dental sac (Fig. 7).

The maxillary lesion often produced some elevation of the floor of the orbit, and in 1 case there was also encroachment upon the nasal cavity, which appeared markedly narrowed.

We were not able to carry out observations over an informative period of time because most patients were operated upon as soon as the diagnosis was made. Neither could any opinion be formed as to the late results as they relate to x-ray diagnosis.

Summary of X-Ray Findings: Fibrous dysplasia of the jaws is of three fairly distinct roentgenographic types. The first and probably the most diagnostic of these shows a diffuse, uniform, homogeneous sclerosis (Figs. 3 and 4). The sclerotic form tends to follow the general contours of the bone and to enlarge it as well. It was found in our series only in the maxilla and it made up one-half the maxillary cases.

The type most frequently seen (8 in the mandible and 1 in the maxilla), while somewhat less specific in its roentgen appearance, is still considered to be highly suggestive of fibrous dysplasia. This variety is quite lytic in character, oval in shape, with septa or ridges, a fairly sharp border, cortical thinning and expansion, and frequently calcific strands or flecks. Its essential feature is the x-ray appearance of multiloculation (Figs. 2, 5, 6).

The last specific roentgen type of fibrous dysplasia is the unilocular pattern (Fig. 7). There were only 3 such cases.

The differential diagnosis of fibrous dysplasia of the jaws depends upon which of the three possible x-ray types is encountered. The sclerotic variety bears a superficial resemblance to osteitis deformans, sclerosing cancer metastases, and possibly the sclerosing x-ray type of osteogenic sarcoma (14). In our experience the basic point of differential diagnosis for these

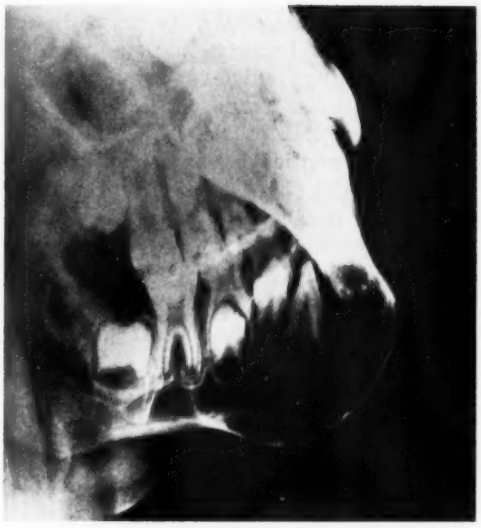

Fig. 7. Unilocular x-ray type. Little or no ridging seen. Wavy border distinguishes this from ossifying fibroma.

three conditions would be the homogeneous uniform character of the increased bone density and general enlargement of the bone occurring in fibrous dysplasia. Other aspects of importance are the absence of extension of disease beyond the intact cortical margin, with no soft parts mass or bone destruction.

There are many diseases that might be mentioned when discussing differential diagnosis in the multiloculated form of fibrous dysplasia, but in general its radiological features are sufficiently characteristic for its recognition.

In the third x-ray type of fibrous dysplasia the differential diagnosis concerns mainly ossifying fibroma and it may well be that a clear distinction will not always be possible.

SUMMARY

Seventeen histologically proved cases of fibrous dysplasia of the jaws were studied roentgenologically. Three fairly distinct roentgen types were recognized: one showing a diffuse, homogeneous sclerosis tending generally to follow the contour of the bone; one a multiloculated appearance,

lytic in character, oval in shape, with septa or ridges, a relatively sharp border, cortical thinning and expansion, and frequently calcific strands or flecks; a third a unilocular pattern.

The differential diagnosis depends upon which of the three types is encountered. The first two types are in general sufficiently characteristic to be distinguished radiologically. In the third type the problem concerns mainly ossifying fibroma and a clear distinction may not always be possible.

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SUMMARIO IN INTERLINGUA

Identification Radiologic De Dysplasia Fibrose Del Maxillas

Dece-septe casos de histologicamente demonstrate dysplasia fibrose del maxillas esseva studiate per medios roentgenologic. In 11 casos, solmente le maxilla inferior (i.e. le mandibula) esseva afficite. In 5, solmente le maxilla superior (i.e. le maxilla in le senso restringite) esseva afficite. In 1 caso, tanto le maxilla superior como le maxilla inferior esseva afficite. Tres satis distincte typos roentgenologic esseva recognoscite. Le plus diagnostic esseva probabilemente le typo que monstrava un sclerosis diffuse e homogenee que tendeva generalmente a sequer le contorno del osso. Le typo le plus frequente presentava un apparentia multiloculate. Illo esseva de character lytic e de conformation oval, con septos o crestas, un relativemente acute margine, tenuification e expansion cortical, e frequentemente bandas o maculas calcific. Le tertie typo habeva un configuration unilocular.

Le diagnose differential depende de qual del tres typos es incontrate. Le prime duo typos es generalmente sufficientemente characteristic pro esser radiologicamente distinguibile. In le tertie typo le problema concerne principalmente fibroma ossificante, e un distinction clar es forsan non semper possible.

Cholesteatoma of the Temporal Bone[1]

HAROLD CHIAT, M.D., and RICHARD D. KITTREDGE, M.D.

CHOLESTEATOMA presents a variable clinical picture with freedom from symptoms for periods of different duration. The roentgen diagnosis is based upon destruction of bone by the tumor (4).

Cholesteatoma develops in a setting of chronic middle-ear infection and a poorly pneumatized mastoid. Perforation of the *membrana flaccida* or of the posterior margin of the *pars tensa* should arouse suspicion of this lesion. In response to infection the stratified squamous epithelium from the external auditory canal extends through the perforation. The mucosa is gradually destroyed and replaced by epidermal cells as a result of extension of epidermis from the external auditory canal through the ruptured drum, or by cellular metaplasia of the cuboidal-cell lining within the middle ear. The desquamated débris gradually collects and forms a constantly enlarging mass, which erodes the adjacent bone. Antibiotics have no effect on the growth of a cholesteatoma. The *tegmen tympani* may be destroyed, allowing the cholesteatoma to enter the middle fossa. The posterior wall of the external canal may show erosion. The mastoid antrum may be grossly enlarged.

Roentgen examination may detect a cause of cholesteatoma that has not manifested itself clinically or may confirm the clinical diagnosis and outline the extent and anatomy of the lesion. It is the purpose of this paper to summarize the criteria used in the roentgen diagnosis of cholesteatoma and to point out the usefulness of tomography in this disease.

In a ten-year period between 1947 and 1957 there were performed in the Section of Otolaryngology of the Department of Surgery of The New York Hospital 40 endaural radical mastoidectomies and 34 endaural modified mastoidectomies. Of the 74 cases, 2 were diagnosed postoperatively as carcinoma and 72 as chronic suppurative otitis media with perforation. At operation 28 cholesteatomas were found. Of these 28 cases, 3 had inadequate film coverage. Routine roentgenograms of the remaining 25 patients were available for study. It was possible to make a preoperative roentgen diagnosis of cholesteatoma in 13 instances. This result is in accord with other reports, showing a preoperative roentgen diagnosis in 45 to 68 per cent of the cases proved by operation (1, 2, 5).

Routine examination of the mastoids in the Law's, Mayer's, and fronto-occipital positions has consistently shown that a cholesteatoma, if demonstrable radiologically, will most often be clearly defined on the fronto-occipital view. The most important diagnostic feature is an enlargement of the mastoid antrum. Law's view will not demonstrate the antrum because of the superimposition of the dense labyrinthine mass. Mayer's view can demonstrate the antrum, but minimal abnormalities may be difficult to see. The fronto-occipital view projects both mastoid antra clear of other shadows and affords good definition of these structures (1, 2, 5).

The antrum can be demonstrated in diseased sclerotic mastoids as an area of diminished density. Obviously, it is important to be able to define the size of the normal antrum. Anatomical studies have established the normal range. One of the most graphic of these was done by Waltner (5), who examined serial sections of 16 sclerotic mastoids. Measurements showed that the transverse diameter of

[1] From the Department of Radiology, The New York Hospital-Cornell Medical Center, New York, N. Y. Accepted for publication in February 1958.

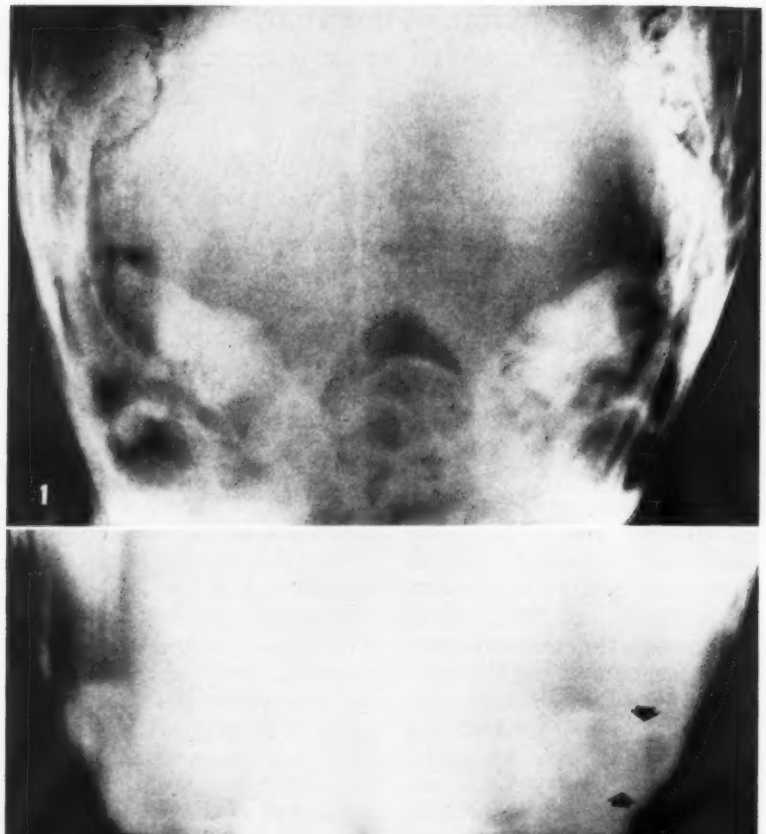

Fig. 1. Preoperative roentgenogram of a nineteen-year-old male with chronic bilateral middle-ear infection, demonstrating sclerotic mastoids with a poorly defined lytic defect in the region of the left mastoid antrum. Because of difficulty in measuring the extent of the defect, tomography was done. See Fig. 2.

Fig. 2. Tomogram revealing a well defined, large lytic lesion measuring 20 mm. in height, and 12 mm. in width at its lower third. At operation a large cholesteatoma involving the antrum and middle ear was removed.

the normal antrum may exceed 6 mm. in its upper two-thirds but is almost never over 6 mm. in the lower third. The upper limit for the vertical diameter is 11 mm., with occasional exceptions up to 12 mm. We therefore used 12 mm. height and 6 mm. width (measured near the base) as the upper limits of normal.

Despite these clear-cut dimensions which define the normal antrum, certain practical difficulties can obscure the diagnosis. Some antra are of small size, and minimal or moderate enlargement cannot be detected by applying the measurements discussed above. Obviously, a radiographic diagnosis of cholesteatoma can-

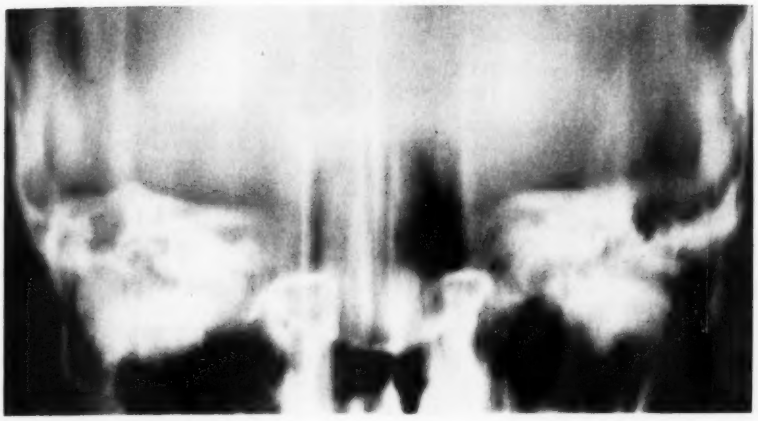

Fig. 3. A forty-year-old female with a right chronic middle-ear infection was found to have a sclerotic mastoid on preliminary roentgen examination. A fronto-occipital view showed a poorly defined defect in the region of the right mastoid antrum.

The tomogram demonstrates a mastoid antrum of normal size, 10 × 4 mm. The normal anatomy of the middle ear and the petrous pyramid is extremely well demonstrated. See also Fig. 4.

not be made in such a case. Inflammatory change with granulomatous reaction and chronic osteitis may cause defects in or at the region of the antrum. It has been stated that in the case of enlargement of the attic or antrum a distinct outline favors cholesteatoma while an indistinct one favors an inflammatory osteitic process (3). There may also be difficulty in defining the true margin of the bone defect clearly enough for measurement. In such situations tomography of the temporal bone can be extremely helpful and will increase the number of cases which can be correctly diagnosed radiographically (6) (Figs. 1–4).

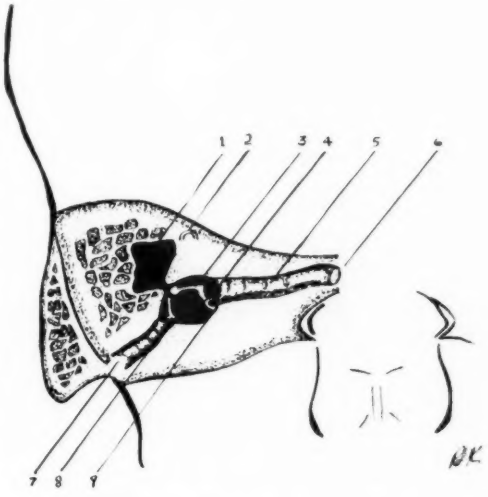

Fig 4. Drawing of Figure 3. 1. Mastoid antrum. 2. Superior semicircular canal. 3. Long crus of incus. 4. Stapes. 5. Internal auditory canal. 6. Internal auditory meatus. 7. External auditory canal 8. Handle of malleus at membrana tympani. 9. Fenestra vestibuli.

SUMMARY

We have reviewed all the cases of cholesteatoma of the temporal bone seen at The New York Hospital from 1947 to 1957. The practical problems arising in the roentgen diagnosis of this lesion have been discussed. Tomographic studies in selected cases will make possible accurate measurement of the mastoid antrum and visualization of the anatomy of the petrous bone. In this way destructive changes produced by choiesteatomas will be clearly demonstrated and the number of cases which can be correctly diagnosed will be increased.

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SUMMARIO IN INTERLINGUA

Cholesteatoma Del Osso Temporal

In un serie de 74 mastoidectomias effectuate in un periodo de dece annos al Hospital New York, 28 cholesteatomas esseva trovate, incluse 13 in que un roentgenodiagnose poteva esser effectuate.

Le plus importante characteristica diagnostic es le allargamento del antro mastoide, discernibile le melio in le vista frontooccipital. Ben que le dimensiones normal del antro es completemente clar (valor maximal del altor 12 mm e del largor al base 6 mm), certe conditiones pote exister que obscura le diagnose. In tal situationes, tomographia es a recommendar. Per illo, alterationes destructive in le osso pote esser demonstrate clarmente e le numero del casos in que le correcte diagnose es obtenite pote esser augmentate.

Carcinoma in a Well-Functioning Gallbladder[1]

CHRISTIAN V. CIMMINO, M.D., F.F.R.[2]

MODERN RADIOLOGY of the gallbladder with its excellent contrast media and efficient spot-film technics (1) is especially suited to the easy demonstration of noncalculous filling defects. Herewith is reported an example of frank adenocarcinoma of the gallbladder with excellent concentration of the contrast medium, a rare observation (2).

Figure 1 represents the gallbladder of a 45-year-old man with upper abdominal complaints compatible with gallbladder disease. Aside from several minute stones that gravitated to the fundus, there was a constant filling defect measuring 5 × 10 mm., apparently related to the medial wall. Roentgenologically, "a neoplasm could not be excluded." Study of the surgical specimen by Dr. C. P. Barnette, formerly Associate Professor at Hahnemann Medical College, disclosed that this noncalculous filling defect was a frank "papillary adenocarcinoma, noninvasive" (Fig. 2).

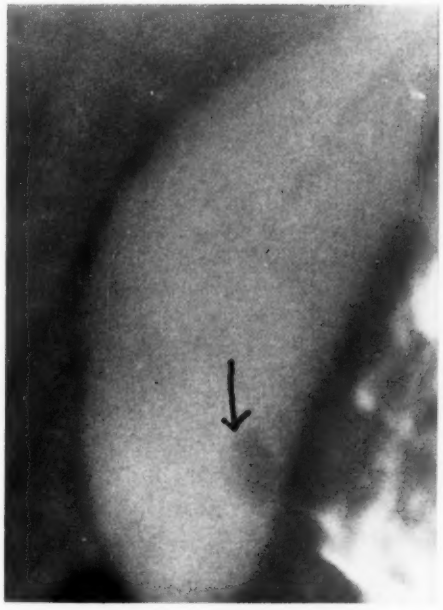

Fig. 1. Fixed, noncalculous filling defect in the gallbladder, due to adenocarcinoma.

Noncalculous filling defects within the gallbladder can be divided into four groups as follows:

1. *Metabolic (focal cholesterolosis):* This group is the most numerous. The lesions are usually small and multiple, and sharply outlined; they tend to spare the fundus, and the concentration of contrast medium by the gallbladder is usually excellent. The filling defect represents focal subepithelial cholesterol deposits.

2. *Inflammatory:* Filling defects of inflammatory origin represent overgrowth of the epithelium toward the lumen of the gallbladder, under the stimulus of chronic infection. The concentrating power of the gallbladder is usually suboptimal. When the proliferation is directed within the wall, Rokitansky-Aschoff sinuses result.

3. *Neoplastic:* In addition to the rare mesenchymal growths (lipoma, fibroma, etc.), there are the much more important epithelial tumors of the gallbladder, those which are potentially malignant, such as adenoma and papilloma, and the frank carcinomas. The lesion in these cases is usually single.

4. *Malformations:* The dimpled hemispherical defect protruding into the lumen from the fundus of the gallbladder is the commonest example of this group. The lesion has been called by many names (3, 4), adenoma, adenomyoma, adenomyosis, cholecystitis glandularis proliferans, myoepithelial anomaly, all attesting to the wide variety of opinions concerning the pathogenesis—neoplasm, a special response to infection related to the Rokitansky-Aschoff sinuses, heterotopia, and failure in the normal orientation of the

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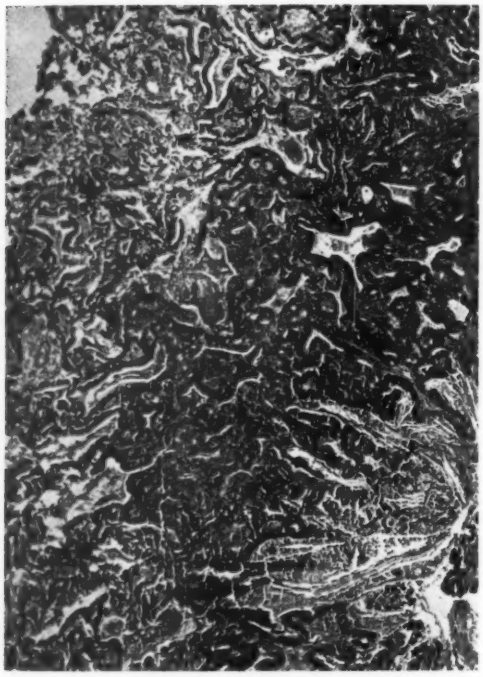

Fig. 2. Photomicrograph showing frank adenocarcinoma.

cells in the tip of the gallbladder bud. The author has recently seen a nonspecific filling defect in the gallbladder that proved to be due to aberrant pancreas, but this was well away from the fundus.

While a differential diagnosis of these noncalculous filling defects within the gallbladder may be attempted on the basis of size, number, sharpness of outline, position, and function of the gallbladder, none of these criteria is sufficiently accurate to justify the risk of missing a potentially or frankly malignant lesion. If for no other reason, the author believes that all noncalculous filling defects within the gallbladder constitute an adequate indication for surgical exploration.

SUMMARY

An example of adenocarcinoma of the gallbladder with good concentration of the contrast medium is described. Since the roentgenologic diagnosis of noncalculous filling defects is insecure, these are an adequate indication for surgery lest a malignant or potentially malignant lesion be missed.

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SUMMARIO IN INTERLINGUA

Carcinoma In Un Ben-Functionante Vesica Biliari

Es describite un exemplo de adenocarcinoma del vesica biliari con bon concentration del substantia de contrasto.

Il existe quatro typos de non-calcular defectos de replenamento intra le vesica biliari· metabolic (cholesterolosis focal), inflammatori, neoplastic, e representante un malformation. Proque le criterios diagnostic non es sufficientemente accurate pro le differentiation de iste defectos, lor demonstration es un indication pro le exploration chirurgic. Isto sol elimina le risco del non-detection de un lesion maligne o potentialmente maligne.

A Simple and Accurate Method of X-Ray Pelvimetry[1]

MICHAEL BRUSER, M.D.[1]

IF ONE AGREES that x-ray pelvimetry is ever of value, one must demand that the method used fulfill the basic criteria of safety, accuracy, ease of taking films, and ease of reading them. Because other methods fail in some or several of these requirements, a new procedure has been devised. It is based on the principle that, if the distance from the object to the film is known, the distortion of measurement due to the divergence of the rays may be overcome by reference to a known correction factor for that distance, provided the tube-film distance remains constant. This method embodies the advantages of simplicity for the radiographer, a built-in method of checking any error on the part of the technician, a minimum of movement for the patient (which is a particular advantage when she is in labor), ease of film reading and of measuring, and maximum accuracy.

A special seat has been constructed (Fig. 1) to be placed on the x-ray table. Under the seat is a chamber for a film cassette; at one side another (vertical) chamber accommodates a second cassette. An adjustable back rest permits correct positioning of the patient for a true inlet film. On the top of the seat, running in an anteroposterior direction, is a metal measuring rod, 1 cm. in diameter, with circular grooves around it at 1-cm. intervals. This is 21 cm. from the vertical film cassette.

The patient is seated in such a manner that the front end of the measuring rod is visible in the midline, directly beneath the symphysis pubis, and the other end may be seen between the cleft of the buttocks, directly in the center of the sacrum, at the back. Two films are taken, one lateral and one supero-inferior, each with a focal-film distance of 40 inches.

Before the patient is seated, a sheet of lead is placed over the left half of the seat; this cuts down secondary radiation while the lateral view is being obtained, and can then be removed. A second lead sheet, on the bottom of the horizontal slot under the seat, remains always in place; the film cassette for the vertical view fits above this lead sheet. A stationary grid is used for each film.

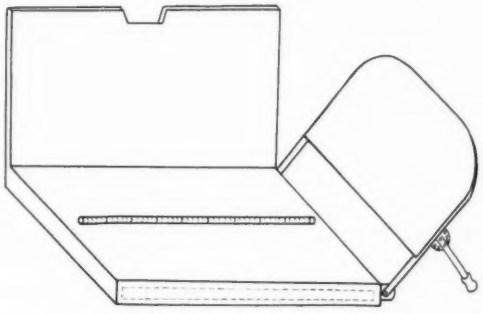

Fig. 1. Seat to be placed on the x-ray table. The back is not shown in proper perspective. Actually it is considerably higher than it appears here.

With a fixed (40 inches) focal-film distance, a grid is made as in Figure 2, which shows the equivalent of a centimeter scale at points from 1 to 24 cm. above the seat top. A transparency is made of this grid on x-ray film. On this two other distorted scales are marked. Both of our views are taken with a focal-film distance of 40 inches. Since the measuring rod on the seat top is at a fixed distance from each film, the distortion of the centimeter grooves on the rod is the same for all inlet films and for all lateral films. These two scales are included on the transparency.

Both films should be on the viewing box at the same time (Figs. 3 and 4). First, one checks on the technician. Are these true lateral and true inlet films? In a true lateral, the acetabula and the spines should be nearly superimposed, and in a

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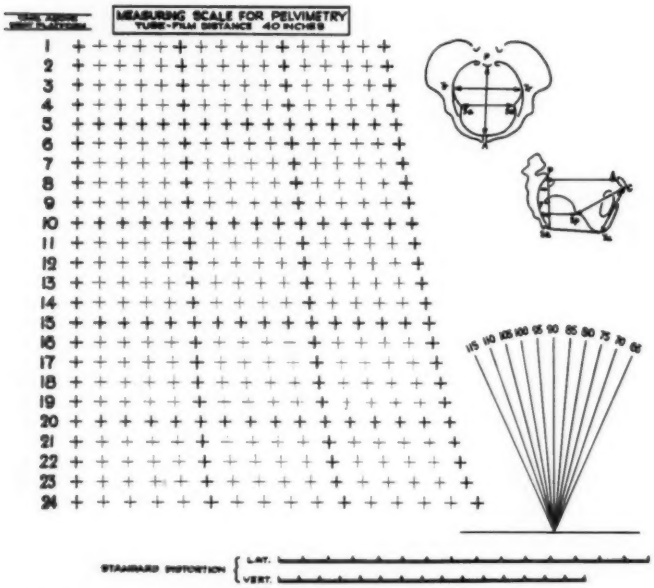

Fig. 2. Transparent correction scale. Two tracings on this transparency represent lateral and inlet views of an average pelvis. Marked on these are the diameters to be measured. A protractor is also included so that various angles may be directly measured.

true inlet film, the obturator foramina should be almost totally obscured. This may be determined at a glance. Was the tube at the proper distance? On our transparent grid are the correction factors for both the lateral and the vertical films; if the shadows of the measuring rod on this scale are superimposed on the shadow of the measuring rod on the appropriate film, one may in a moment determine whether each tube-film distance was correct when the films were taken.

LATERAL VIEW

From the lateral view, one makes the standard anteroposterior measurements, using the appropriate scale on the transparency. These diameters are marked on the film. They are essentially those described by Steele and Javert (1) in 1942; the anteroposterior inlet line used is in the plane of the ileopectineal lines, as originally recommended by Caldwell and Moloy (2) in 1933. It is probably also wise to measure and record the shortest anteroposterior diameter at about inlet level.

The posterior sagittal diameter of the midpelvis is from the midpoint between the tips of the ischial spines, parallel to the anteroposterior inlet line, to the anterior surface of the sacrum. The posterior sagittal of the outlet is from the tip of the sacrum to a point halfway between the lowest points of the ischial tuberosities. The anterior sagittal of the outlet is from this latter point to the lowest border of the symphysis. From here, the anteroposterior of the outlet extends to the tip of the sacrum.

Using the same scale, one measures the following distances above the lowest part of the shadow of the measuring rod (seat top): (*a*) a point halfway between the tips of the ischial spines; (*b*) a point halfway between the lowest parts of the ischial tuberosities; (*c*) a point (determined from the inlet film, as described below) where the widest transverse diameter intersects the midline anteroposterior diameter of the inlet.

These figures are written on the film for use in studying the inlet (vertical) film.

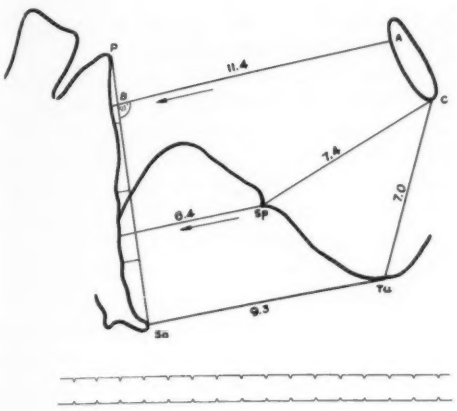

Fig. 3.

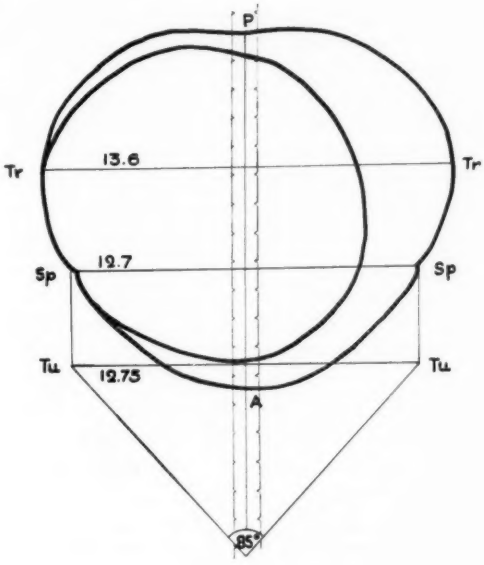

Fig. 4.

INLET FILM

The transverse diameters at any level are measurable on the inlet film with considerable accuracy. The method for measuring the interspinous distance will be taken as an example.

The tips of the spines are outlined and a line is drawn joining them. By referring to the lateral film, we find that we have marked on it the distance of the spines above the seat top, as, for example, 5 cm. The distortion at this level corresponds to the "5" line of the transparent measuring scale: this is applied directly to the line joining the tips of the spines on the inlet film and the distance is recorded.

For measuring the widest diameter at the inlet, the same technic may be used if the inlet line on the lateral film is parallel to the seat top. If not, then different parts of it are at different distances from the film and have different distortions. This may be corrected as follows:

The line of the widest transverse diameter is drawn on the inlet film, and its point of intersection with the central anteroposterior line, indicated by the shadow of the measuring rod, is marked. This point is measured as so many true centimeters in front of the promontory and so many centimeters behind the symphysis. These two figures are expressed as a ratio, as, for example, 2/3 of the way back or 1/2 of the way back. Using this ratio on the lateral film, *e.g.*, 2/3 of the way back from the posterior surface of the symphysis, one marks this point on the line indicating the anteroposterior inlet measurement. This is the point referred to above, when the lateral film measurements were being discussed. The distance of this point above the seat top is measured, *e.g.*, 12 cm. This corresponds to the "12" line on our transparent measuring scale, and a direct measurement is taken.

OUTLET MEASUREMENTS

Thoms (4) states: "Clinical methods of examination can be relied upon to furnish an estimation of outlet pelvic capacity and thus serve as a valuable adjunct to the general x-ray survey of the pelvis." He does not, however, describe any method of x-ray measurement of the transverse diameter of the outlet, and it is doubtful if the accuracy of this measurement can be raised to the point where it may become valuable, without added radiation exposure. For example, the method of measurement of the intertuberous diameter as described by Steele and Javert

(1) in 1942 is very different from that given by Walsh *et al.* (3) in 1954, and their figures differ significantly. In both, the end-point is arbitrarily chosen by criteria which are not supported—yet these writers were describing exactly the same pelvimetric procedure.

Several methods of measurement of the intertuberous diameter have been investigated, making use of our two films. At present, efforts are being directed toward assessment of the relative accuracy of two of these methods and also of a third, based on this diameter, including a measurement of the subpubic angle. This latter measurement will be based on the same measurements as are used in the Colcher-Sussman method (5), but it is intended that it will include an accurate line drawing of the angle on the film. Such actual visualization of this angle is considered to be of real value in the obstetric assessment of the pelvis. Should these additions prove satisfactory and valuable, they will be the subjects of a subsequent report.

PELVIC INDICES

Various pelvic indices were studied. It probably should be pointed out that such indices, calculated from different technics and employing different end-points, will vary in their prognostic value, and cannot be applied to the method described here. As this is more widely employed, its usefulness in regard to the formulation of helpful indices will increase.

SUMMARY

1. A method of isometric 90° triangulation pelvimetry has been described which embodies the following advantages: It is simple for the technician, who has only one measurement to make, namely, the focal-film distance. Any error in this respect can readily be noted by the radiologist or obstetrician. It can be performed rapidly and is easy for the patient, requiring an absolute minimum of movement and only two exposures.

2. A seat to be placed on the x-ray table and a new transparent correction scale are described. The scale may be made individually by those wishing to use this technic, to suit their own conditions. If both the seat and scale were factory-produced, the only measurement required by the user would be the 40-inch tube-film distance.

This method of pelvimetry, although probably of maximum accuracy and simplicity, requires further experimentation and testing if optimum results are to be achieved. Certain indices require evaluation, as does also a method of cephalometry. The technic is published at this stage of development in order to invite criticism, and that others who may be interested may make further tests or contributions.

ACKNOWLEDGMENTS: This work was begun under the auspices of the Mall Medical Group, Winnipeg, Manitoba, and in 1954 had reached the point where more extensive trials could be undertaken. Accordingly, by special arrangements with the Chairman of the Department of Obstetrics and Gynecology and the Chairman of Diagnostic Radiology of the Winnipeg General Hospital, testing was carried out at that institution on a wide scale. Mr. William Doern, R. T., gave a great deal of his time, and many useful suggestions as to screening and technic. This type of x-ray pelvimetry is now standard at Misericordia General Hospital, Winnipeg.

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SUMMARIO IN INTERLINGUA

Un Simple E Accurate Methodo De Pelvimetria A Radios X

Es describite un methodo de pelvimetria isometric con triangulation a 90 grados. Durante le manovra le patiente se trova in un specialmente construite sede super le tabula a radios X. Le dorso del sede es adjustabile e permitte positionar le patiente pro le obtention de un ver prisa del stricto superior. Un cassetta es installate in un camera infra le sede; un secunde al latere. Sur le sede se trova un mesura metallic, placiate in direction antero-posterior e graduate in centimetros per gravationes circular.

Le manovra es simple pro le technico qui debe facer non plus que un sol mesuration, i.e. le distantia inter foco e pellicula. Le manovra pote esser executate rapidemente; le mesurationes es facile a facer; e un minimo de movimento es requirite ab le patiente. Solmente duo expositiones es necessari.

Le methodo es probabilemente distinguite per un alte grado de accuratia e de simplicitate, sed illo require experimentation e tests additional pro assecurar le obtention del melior resultatos possibile.

Es describite un nove scala de correctiones pro le uso con iste methodo.

Preparation of the Colon Prior to Barium Enema[1]

GEORGE N. CHUCKER, M.D., and WM. P. GILMER, M.D.

NOTHING IS more discouraging in the course of colonic examinations than the multiple filling defects indicative of intestinal contents, globules of mineral or vegetable matter, air bubbles, or even grease. The problem, as it presents itself, lies in the hands of the diagnostic radiologist. He must initiate a procedure which will not only be adequate for a conclusive barium-enema study but also facilitate specialized examinations to be performed in sequence, as the need may arise.

In reviewing the limited literature available on the preparation of the colon prior to a barium enema, we found some short excerpts in various books and periodicals. We have also obtained from other institutions information as to their routine for comparison with the method which we are now using.

Proper preparation is of the utmost importance, first, to avoid the excessive radiation incident to repeat examinations; second, to make adequate diagnosis possible. The preparation of the colon is not only time-consuming but also involves a great deal of discomfort for the patient. We believe that it is our responsibility to provide a routine which is not prolonged but is adequate for good diagnostic evaluation.

PROCEDURE

I. The patient receives a clear liquid diet on the day prior to the examination. If this is impossible, the dinner at least, consumed after 5 or 6 P.M., should consist only of liquids, such as orange juice, tomato juice, coffee (without milk or cream), and tea.

II. At 6 P.M., 60 c.c., or 2 oz., of castor oil are given, preferably in orange juice. If convenient, the castor oil may be given at 4 P.M., so that the patient will not have his rest interrupted during the night.

III. Nothing is taken by mouth after midnight; however, juices are permissible up to that time.

IV. At 6 A.M. two soapsuds enemas, between 800 and 1,000 c.c. each, are given. Initially these enemas must be administered with the patient in bed, lying on his left side. Approximately 500 c.c. of the soapy solution is introduced. The patient is then turned on the right side, and 500 c.c. or more of the solution is given in this position if the patient is able to tolerate it. We usually try to use a bulb catheter, though an ordinary catheter will suffice. The procedure is more effective if the patient is able to hold the solution for several minutes after the injection has been completed, as the distention of the colon initiates peristalsis and the irritating action of the soap upon the mucosa causes a to-and-fro type of peristalsis which in itself has a tendency to sluice the colonic walls. Following this part of the procedure, the patient is allowed to expel the enema in the commode.

After the second soapsuds enema, the patient is returned to the bed and 1,000 c.c. of warm water, containing about three-quarters of a teaspoon to a teaspoon of tannic acid powder is instilled. The powder is well mixed in the warm water and the solution has a brownish appearance. The same maneuver as described above is used in administering the tannic acid solution. It is especially important that it reach the cecum. If the solution produces immediate cramps, the patient should be allowed to expel it and a weaker solution should be substituted. When cramping is severe, we have found a warm-water enema, given immediately, very effective in affording relief.

The tannic acid enema has several advantages: (a) The mixture is irritating to the mucosa and stimulates the contraction of the entire colon. (b) The

[1] Accepted for publication in March 1958.

tannic acid is an astringent and inhibits the secretion of mucus as well as the transudation of fluids into the lumen of the colon. (c) The viscosity of the tannic acid causes the barium to adhere to the bowel wall. (d) Due to a continuous contraction of the entire colon from the cecum to the rectum, the residual intestinal contents, especially gas, are forced from the colonic tract. We know of no other procedure that will cause the explusion of gas from the colon with the force and completeness attained with a tannic-acid enema.

V. A plain warm-water enema is given in approximately the same volume and the patient is asked to hold this solution until peristalsis commences. It is essential during this part of the procedure that no air be introduced into the colonic tract, since most of the gas has already been eliminated.

VI. Food and liquids are omitted in the morning in order to prevent stimulation of the gastrocolic reflex. If this reflex is stimulated after cleansing of the colon, filling of the cecum may occur from the terminal ileum, thus rendering the careful preparation ineffective and the examination of the cecum indeterminate.

VII. After completion of the barium enema, the patient is returned to his room and a soapsuds enema is administered to remove the residual barium. This facilitates the performance of other examinations, if necessary.

Like other radiologists, we prefer to have proctoscopy or sigmoidoscopy done at another time. Where the out-patient work is heavy, and the patients come from long distances and are able to remain only a few days at the diagnostic clinic or hospital, we have to do the barium enema after sigmoidoscopy has been performed. In that event, the patient may be prepared for sigmoidoscopy by administration of two good soapsuds enemas. After sigmoidoscopy, he is returned to his room, where another soapsuds enema is administered, followed by a tannic-acid enema which, in turn, is followed by a warm-water enema. We have found that this procedure is well tolerated and that it gives excellent results. Occasionally the soapsuds enema may be omitted after sigmoidoscopy and the tannic-acid and warm-water enemas may suffice. There are several points which we wish to stress:

A. Bulky foods should be omitted on the day prior to the barium enema.

B. Castor oil should be omitted in patients who have severe diarrhea or those who are bleeding a great deal.

C. We believe that in most of the patients who receive soapsuds enemas or tap-water enemas the amount of solution is not sufficient to cleanse the right side of the colon. It is essential that the quantity injected into the colon be adequate to remove any intestinal contents that may be adherent to the bowel wall. There is no harm in administering as much solution as the adult patient is able to tolerate, providing it is not much more than a quart.

D. In patients who have an active ulceration or severe diarrhea, several warm-water enemas may be adequate, providing they are administered in the recumbent position while the patient is rolled from left to right, as previously described.

E. It is important not to keep the patient waiting too long after administration of the warm-water enema before commencing the barium enema.

F. Another institution which has occasionally used tannic-acid enemas prior to barium enemas recommends a 1 per cent solution. In our experience this solution has proved entirely too strong, producing severe cramping. After performing several hundred enemas, using from three-quarters to one teaspoon of tannic acid powder per 1,000 c.c. of warm water, we have found that this solution does not cause marked irritation or cramping. A very strong solution (1 per cent) irritates the colon to a point which necessitates two or three warm-water enemas to bring the colon back to a quiescent state. With the dose prescribed by us, the colon reverts to its physiologic state

immediately after the warm-water enema is given.

G. A low residual diet for several days prior to the examination is advantageous. However, because of the time element, it may have to be omitted. It should certainly be maintained if possible.

After the patient has been prepared according to our procedure, excellent studies of the lumbosacral spine, pelvic examinations, intravenous pyelograms, and cholecystograms have been obtained with very little disturbance from the overlying gaseous shadows.

It is our belief that the addition of this procedure to our armamentarium will greatly enhance the diagnostic accuracy on the first examination.

NOTE: If others are led to try this procedure, the authors would greatly appreciate their comments.

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SUMMARIO IN INTERLINGUA

Le Preparation Del Colon Ante Le Application De Clyster A Barium

Le uso de un clyster a acido tannic ante le application del clyster a barium pro le examine del colon se ha monstrate avantagiose. Le routine del autor es le sequente: Un dieta liquide es observate le die ante le examine, con oleo de ricino a 18:00 horas. Le matino del examine, duo clysteres a aqua de sapon es administrate, sequite per le introduction de un solution de acido tannic in aqua calide (inter tres quarte e un coclearata a the de acido tannic per 1.000 cm cubic de aqua). Postea un clyster a aqua calide simple es administrate e retenite, si possibile, usque le peristalse comencia. Post le completion del studio a barium, un secunde clyster a aqua calide es administrate pro eluer residuos de barium. Si crampos sever occurre post le introduction del solution de acido tannic, illo pote esser expellite. In iste caso un clyster a aqua calide es administrate immediatemente.

Le mixtura de acido tannic irrita le mucosa e stimula le contractiones del colon integre, de maniera que le residue contento intestinal, specialmente gas, es expellite vigorosemente. Le acido tannic preveni le secretion de muco e le transsudation de fluidos verso le interior del colon e promove le adhesion del barium al parietes intestinal.

A Simple Universal Unit System of Radiographic Exposures Suited to Departmental, National, and International Standardization[1]

GERHART S. SCHWARZ, M.D.

Several hundred radiographs of a multiple-step Masonite-bone phantom imitating a variety of anatomical parts from fingertips to the lumbosacral spine were examined by an optimum matching method for the purpose of establishing the exact halving and doubling kilovoltages at which the milliampere seconds could be reduced to 1/2, 1/4, etc., or had to be increased 2×, 4×, etc., in order to produce radiographs with a photographic bone density equal to that of a master radiograph taken at 60 kvp. These data were then adjusted to clinical conditions. The correct exposure factors for all thicknesses from 2 to 42 cm., and all voltages from 40 to 122 kvp (and selected values for 0.5–2 cm. and 28 to 125 kvp) were charted on a table. This table made it apparent that there exists no universal exponent[2] governing the function: *radiographic effect* = $c.kvp^n$. However, by cutting diagonally across the table from the lower kilovoltages for the thinnest anatomical parts to the highest kilovoltages for the thickest parts, it was easy to select those doubling points and halving points which corresponded to actual working conditions over a wide range, from 0.5 cm. at 33 kvp to 42 cm. at 122 kvp. Thus it was possible to establish an index number system analogous to the EVS (exposure value scale) system now internationally accepted for photography. It consists of labeling a limited or unlimited choice of the three basic machine control settings (kvp, ma, and timer) with index numbers so that each unit step-up represents a doubling of the radiographic effect, which can be compensated for by a unit step-down of one of the other two controls. This leads to the following proposed ASA and international standards:

For Kilovoltages

Unit No.:	−3	−2	−1	0	1	2
Kvp:	30	33	37	43	51	60

Unit No.:	3	4	5	6	6.5	(7)
Kvp:	71	83	98	115	125	(136-app. estimate)

For Milliamperage

Unit No.	0	2	3	4	5	6	6.5
Ma:	12.5	50	100	200	400	800	1,100 etc.

For Timer Setting

Unit No.:	[0]	1	2	3	4	5
Seconds:	1/1000	1/500	1/240	1/120	1/60	1/30

Unit No.:	5.5	6	6.5	7	7.5	8	8.5	9
Seconds:	1/20	1/15	1/10	2/15 (=1/8)	1/5	1/4	2/5	1/2

Unit No.:	9.5	[10]	10.5	11 etc.
Seconds:	4/5	*1.0*	1.4 (=1 1/2)	2.8 (=3)

Operation of the Unit System: An ordinary radiographic patient caliper is re-labled so that it reads in exposure value numbers instead of in centimeters. For Blue Brand film, par-speed cassettes, full five minutes development or X-omat processing, 3.5 mm. Al filtration, the following caliper labeling was found to be correct:[3]

For No-Grid Table-Top Technic, T.F.D. 40

EV No.:	5[4]	6[4]	7[4]	8	9	(9.5)
Cm.:	0.3	0.5	1.0	1.5	5	(6.5)

EV No.:	10	(10.5)	11	(11.5)	12
Cm.:	8	(10)	11	(12.5)	14

For Bucky Grid Technic, T.F.D. 40

EV No.:	10	11	12	13	14	15	16	17	18	19	20
Cm.:	4	6	8	10	13	16	20	24	28	34	40

For 2-Meter and 6-Ft. Chests, No-Grid Technic

("light technic"; for dark films add one unit No. up to 30 cm.)

EV No.:	10	10.5	11	11.5	12	12.5
Cm.:	12	14	16	18	20	22.5

EV No.:	13	13.5	15	15.5	16
Cm.:	25	28.5	32	35	40

The x-ray technician measures the anatomical part to be radiographed in EV numbers and sets the three basic machine controls (kvp, ma, and time) upon those unit numbers the sum of which equals the exposure value shown on the caliper. This produces a correct exposure regardless of kilovoltage or other individual factors chosen.

Intentional Restriction of the Technician's Choice of Setting: A further simplification of the system was introduced by limiting the control panel labels to a narrower range of voltages and timer settings. The index figures are then lower, so that the highest sum to be totaled mentally by the x-ray technician is 12. This reduces the mental effort and increases

[1] From the Department of Radiology, College of Physicians and Surgeons, Columbia University, and the Radiological Service of the Presbyterian Hospital, New York City.

[2] For the range of 8 cm. at 60 kv to 42 cm. at 122 kvp a compromise exponent of $n = 4.3$ could be established, but for lower voltages n rose rapidly to 6, and for high voltages and thin parts dropped as low as 2.5. This is in fair agreement with the work of Mattson.

[3] For high-speed screens subtract a half-step, for high-speed screens with Royal Brand film subtract a full step, for three-minute development add a half-step.

[4] Used in animal radiography.

the speed of operation. For a high-kv technic, the control panel then assumes the following appearance after application of the labels:

Voltage

Unit No.:	0	1	2	3	4	(optional:	4.5)
Kvp:	60	71	83	98	115	(optional:	125)

Milliamperage

Unit No.:	0	1	2	3
Ma:	50	100	200	400

Timer

Unit No.:	0	1	1.5	2	2.5	3	3.5	
Seconds:	1/60	1/30	1/20	1/15	1/10	2/15 (=1/8)	1/5	
Unit No.:	4	4.5	5	5.5	6	6.5	7	7.5	8
Seconds:	1/4	2/5	1/2	4/5	1	1 1/2	2	3	4 etc.

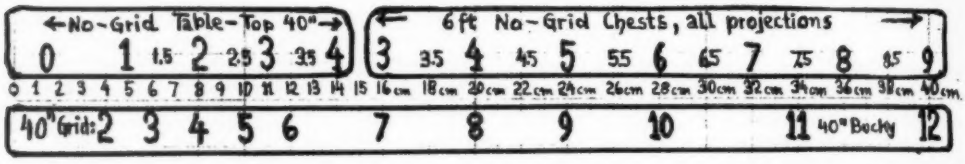
The caliper EV figures are now (regardless of kv range):

Example: A 1.5-cm. finger measures zero EV units on the caliper. In order to attain a sum of settings equal to zero, the technician has only one choice: to set his control on 0 (60 kvp) plus 0 (50 ma) plus 0 (1/60th second). This will produce a correct exposure with no-grid table-top technic.

Example: The lateral lumbosacral spine view (40 cm.) measures 12 EV units. The most obvious setting is 4 (115 kvp) plus 2(200 ma) plus 6 (1 second). This will produce an acceptable exposure. The technician may select however the settings: 2 (83 kvp) plus 2 (200 ma) plus 8 (4 seconds) and obtain an equivalent though "contrastier" radiograph.

The potentialities of the unit system go beyond mere convenience and speed. It permits operation of medical radiographic units where trained personnel is not available. For the manufacturer it simplifies the design of future x-ray machines by reducing the number of required steps per control. It also provides for mechanical or electrical cross coupling leading to a single knob control.

NOTE: A paper scale which can be pasted over a conventional caliper may be obtained from the author on request to enable other radiologists to use the system. Please state shortest functioning timer setting, highest available kvp, and all ma stations.



(Grid ratio appropriate to kilovoltage used, *i.e.*, Station 0, 1, and 2, ratio = 8:1; for Station 3 and 4, ratio = 16:1)

EDITORIAL

The Specification of Radiation Dose in Publications

Radiation dosimetry has made notable progress since the early days of the use of x-rays. The adoption in 1928 of the roentgen as a unit of dose based upon the ionization produced by x-rays in air, followed by many classical dose distribution studies, changed the application of ionizing radiation to biological material from a qualitative to a quantitative science.

In more recent years, high-energy photon beams, particle beams, and radioactive isotopes have been added to the armamentarium of the radiation worker. These new sources of radiation emphasized the inherent limitations of the roentgen as a unit of dose and, consequently, in 1953 the International Commission of Radiological Units adopted the more general concept of absorbed dose, the unit for which is the rad. The definition of the roentgen was unchanged, but its use was restricted to x-rays and gamma-rays below 3 MEV in energy and the new term "exposure dose" was coined to identify the concept expressed by the roentgen.

The roengten and the rad are both useful units if used correctly, but it must be appreciated that the concepts of exposure dose and absorbed dose, respectively, upon which they are based, are fundamentally different. The exposure dose is a measure of the radiation field to which an object is exposed, while the absorbed dose is a measure of the amount of energy actually dissipated in the object. Unhappily, many radiologists and radiobiologists have considered the distinction between these quantities to be of academic interest only and thus unimportant. This state of affairs is all the more unfortunate because even a modest study of such authoritative documents as National Bureau of Standards *Handbook 62* would contribute greatly to individual understanding of the situation. The fact that so many have been unwilling to make or to profit by such a study and the consequent neglect of many of the pertinent factors involved seems to have resulted in more confusion than clarity in the present use of these dose units.

Nowhere is this confusion more evident than in the radiological literature. It is often impossible for the reader to determine the characteristics of the radiation used, the factors employed in the dose calculations, the measurements upon which calculations were based, and even—in some instances—the location of the point of interest and type of tissue for which the dose was estimated. Occasionally, in spite of this, the dose is confidently quoted in "rads" as a sort of window-dressing attempt to join the current fashion. In many papers there is no way of ascertaining how the authors' dose estimates have been obtained; sometimes these are clearly in error. It must be emphasized that the *quantitative* study of radiation effects is of no value unless careful attention is paid to the details of dosimetry, however irksome these may be. The published account should express the dosimetry clearly.

The reporting of dosimetry could be greatly improved if each prospective author were to have clearly in mind a list of the steps necessary in making a dose estimation and would state the essential factors involved at each step in his report. Such a procedure might also serve to indicate to the author deficiencies in his own dosimetry practices and perhaps improve the accuracy of his dose estimations. Furthermore, if these steps are considered before a radiobiological experiment begins, the radiation worker may be encouraged to examine the circumstances of exposure and

perhaps alter them in such a way that it will be possible to determine the absorbed dose more accurately. (For example, exposing samples in a scattering medium rather than in air will sometimes avoid uncertainties.)

The readers of this journal, we feel sure, are in favor of raising the standards of dosimetry reporting. It is accordingly suggested that all authors of papers involving quantitative radiation effects, clinical or otherwise, provide a description of the circumstances of irradiation and the various factors involved in dose estimation. In the case of beam radiation, this should include at least the following:

1. Type of machine (energy or kv; wave form; filter, if relevant).
2. H.v.l. measured in good geometry, small field.
3. Standardization and constancy check of calibration chamber.
4. Exposure conditions (duration, dose rate, etc.).
5. Conversion factors for exposure to absorbed dose, with specification of each medium or tissue concerned.
6. Description of any unusual features of dosimetry, such as lung or bone corrections.

When radioactive sources are used, different but comparable information should be included.

The Editorial Board of Radiology will expect these items to be included in future publications and will feel justified in returning to the authors papers in which they are omitted, with suggestions for correction. In this policy, it will have the co-operation of the Physics Committee of the Radiological Society, whose services are also available, on request, to prospective contributors.

In order to assist authors in making dosimetry calculations, a detailed check list for beam radiation is appended. This list is based in part upon the new treatment chart now under consideration by the Society.[1] A modification for use with radioactive sources is also to be prepared.

It is believed that if such a policy is adhered to by this and other journals the standard of dosimetry reporting in publications will be improved and it is hoped that the general standard of dosimetry in the country will benefit.

W. K. SINCLAIR, Ph.D., *Chairman*
For the Physics Committee of the
Radiological Society of North America

Check List for Dosimetry Calculations
Beam Irradiation

Calibrated Physical Factors
- Peak energy
- Type of machine
- Ma or curies of source
- Filter
- Half-value layer
- Distance from source to point of calibration
- Calibrated exposure dose rate (r per min in air)

Method of Calibration of Exposure Dose
- Instrument
- Chamber
- Equilibrium cap
- Source of calibration for instrument
- Constancy check of instrument
- Correction applied to instrument readings
  - (*a*) Pressure and temperature
  - (*b*) NBS or other factor
  - (*c*) Stem leakage
  - (*d*) Any other
- Monitor dose control on machine

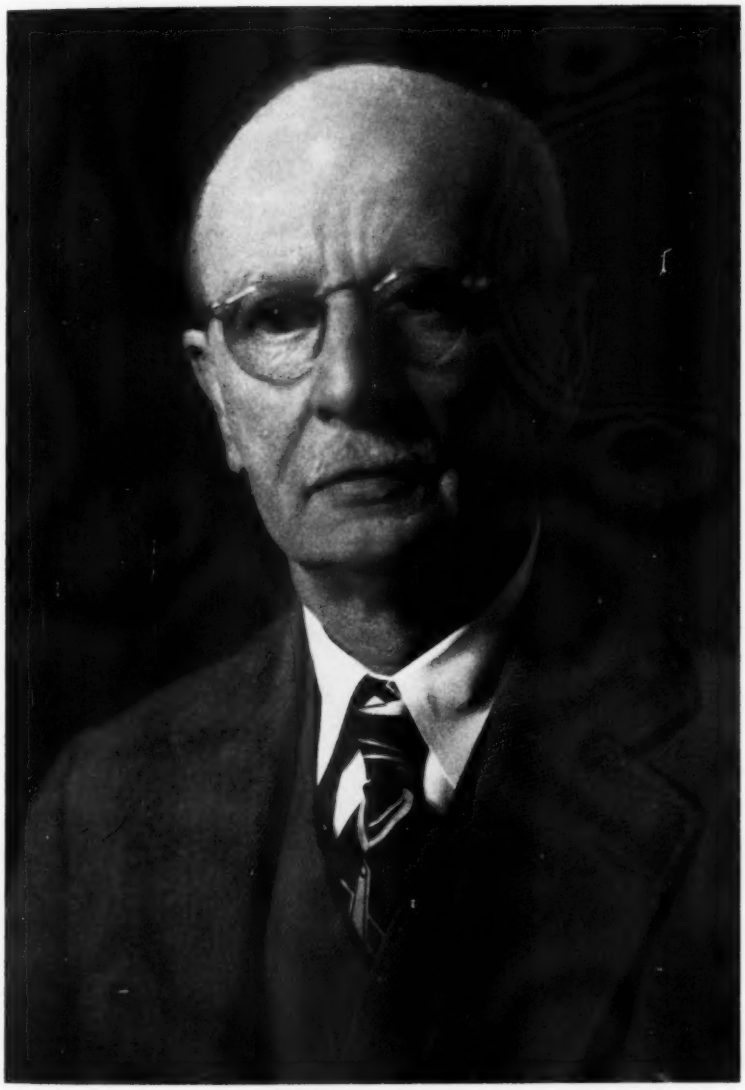
Technic of Exposure
- Type of beam (fixed or moving)
- Location, size, and angulation of radiation fields
- Location of point(s) of interest (relative to surface and source)
- Back-scatter factors
- Exposure dose rate at surface (r per min)
- Per cent depth dose
- Per cent exit dose
- Mean energy of radiatior
- Correction for inhomogeneous absorbing media
- Exposure dose rate at point(s) of interest (r per min)

Estimation of Absorbed Dose
- Composition of tissues of interest
- Mean energy of radiation at these tissues
- Conversion factor, exposure dose to absorbed dose (r to rad)
- Absorbed dose rate at point(s) of interest (rad per min)

Record of Exposure
- Duration of exposure
- Number of exposures
- Total absorbed dose (rads)

Note: A check list of this type cannot apply exactly to all situations, but in most irradiation circumstances very few of the items included are superfluous if sound dosimetry is to be maintained.

[1] To be discussed in a Refresher Course to be presented at the forthcoming Annual Meeting of the Radiological Society of North America.



JOHN MAULFAIR KEICHLINE, M.D.

1878–1958

Death, the quiet haven of us all, came peacefully to John Maulfair Keichline on June 10, 1958, at the Lewisburg Hospital, Lewisburg, Penna., after an illness of many years, during the last four of which he was totally blind. Death was due to arteriosclerosis.

John Keichline was born in Bellefonte, Penna., eighty years ago. He received his early education in the Bellefonte Public Schools and attended Pennsylvania State College for two years, following which he entered military service in the Spanish-American War. Returning from the war, he entered

the American Medical Missionary College in Battle Creek, Mich., and Chicago, Ill., graduating in 1902. He then spent three years as a medical missionary in Cairo, Egypt. When he returned to this country, he established himself in the general practice of medicine in Petersburg, Penna. This was during the formative years of radiology, and it is not surprising that Dr. Keichline became interested in and then an ardent devotee of this new field of medical practice.

It was the custom in those days for x-ray departments to be housed in some unused part of the hospital, and Dr. Keichline accordingly set up his first department in the basement of the J. C. Blair Memorial Hospital in Huntingdon, Penna. For forty years he served faithfully as radiologist on the staff of that institution.

As a result of his professional background, he had developed a most sympathetic attitude toward the clinical problems of the general practitioner and the members of the hospital staff. His valuable contributions and help in the solution of many of these problems created for him a host of friends and established a realization and appreciation of the value of good radiology in medical practice.

Dr. Keichline was vitally interested in the many activities that make up a worthwhile professional life. He faithfully attended the meetings of state and national radiological societies of which he was a member, as well as county and state medical society meetings. These were the only vacations he ever took. For a number of years he served on the Legislative Committee of the Medical Society of the State of Pennsylvania, and he was Secretary-Treasurer of the American Registry of X-ray Technicians. At the time of his death he was an associate member of the American Medical Association, a diplomate of the American Board of Radiology, a Fellow Emeritus of the American College of Radiology, an Emeritus member of the Radiological Society of North America, and a member of the Pennsylvania Radiological Society, of which he was a Past President. For a number of years he was coroner of Huntingdon County and he served as a medical officer in World War I.

His reputation in his community, however, was due not alone to his work as a radiologist, but also to his services as a public-spirited citizen. He "went about doing good." He was active in all manner of civic, charitable, and philanthropic undertakings. He devoted time to the Red Cross, the American Legion, his church, and the Boy Scout movement.

Dr. Keichline was blessed with a happy family life. He was a devoted husband and an affectionate father to his eight children, all of whom, with his wife, survive him. Possessed of a humane philosophy and a capacity for understanding, exercising tireless efforts on behalf of his patients and those less fortunate than himself, he has left a lasting imprint upon the people of the community which he served so faithfully for so many years.

The writer recalls vividly an occasion some years ago when he was enjoying a coffee-break walk with Dr. Keichline at one of the radiological meetings, and his distress at the realization of his rapidly failing eyesight. May we not apply to him the words of Tennyson: "Death has made his darkness beautiful with Thee." P. B. MULLIGAN, M.D.

SIDNEY I. FOLEY, M.D.

1891–1958

Genesee County medicine lost one of its pioneer radiologists with the passing, on March 19, 1958, of Sidney I. Foley, M.D., who established the Department of Radiology at St. Joseph Hospital, Flint, Mich., in the early 1930's. Although partially inactive during the past ten years because of illness, he had maintained his association with Drs. Jackson E. Livesay, Ernest P. Griffin, Jr., and Donald R. Bryant in the practice of radiology at St. Joseph Hospital and in the Mott Foundation Building, Flint.

Dr. Foley was a native of Howe Island, Ontario, and received his medical degree from Queen's University in Ontario in 1914. He completed an internship at Columbus Hospital, New York City, in 1916 and a residency at Lying-In Hospital, New York City, in 1917.

From 1917 to 1919 he was a Captain in the Canadian Army Medical Corps. He was a member of the Canadian Legion.

Dr. Foley moved to Flint in 1920 and opened an office for the general practice of medicine. He had always shown considerable interest in physical medicine and this soon led him into radiology. In 1930 he attended the University of Pennsylvania Graduate School of Medicine for further training in that specialty.

He returned to Flint in 1931 and there established the X-ray Department in St. Joseph Hospital as well as opening his own private office for radiology. He was certified a diplomate of the American Board of Radiology in 1938. He was a member of the American College of Radiology and the Radiological Society of North America as well as national, state, and county medical societies.

Dr. Foley was almost fanatically devoted to the practice of his specialty. Often, though confined to a hospital bed by crippling arthritis, he would ask to be transported to the X-ray Department to do his fluoroscopy from a wheelchair with the help of his technicians. He would then dictate his reports in the same fashion.

In 1926, Dr. Foley married a Flint schoolteacher, Isabelle O'Brien, who died in 1946. He leaves a daughter, Mrs. Frances Sloan, of North Hollywood, Calif.; a son, John Foley, of Flint; a niece whom he

SIDNEY I. FOLEY, M.D.

and his wife adopted, Mrs. Rosemary Stevens, of Swartz Creek, Mich., and four grandchildren.

Dr. Foley was a consecrated member of St. Michael Catholic Church and contributed generously to all its charities. He was devoted to his children and his niece, giving time and energy to them and to the neighborhood children, using his own yard as a playground, with all the facilities which could be provided. In his passing the community has suffered a great loss, both of pioneer radiologist and civic minded man.

DONALD R. BRYANT, M.D.

BUFFALO RADIOLOGICAL SOCIETY

The Buffalo Radiological Society at a recent meeting elected the following officers: President, Dr. Glenn Jones; Vice-President, Dr. Charles Bernstein; Treasurer, Dr. C. Jenczewski; Secretary, Dr. Alfred H. Dobrak, 108 Pine St., Buffalo, N. Y.

RADIOLOGICAL SOCIETY OF HAWAII

The newly elected officers of the Radiological Society of Hawaii are: President, Richard D. Moore, M.D.; Vice-President, Jun-ch'uan Wang, M.D.; Secretary-Treasurer, Robert G. Rigler, M.D., Straub Clinic, 1020 Kapiolani St., Honolulu 14, Hawaii; Councilor to the American College of Radiology, Peter J. Washko, M.D. All the new officers are from Honolulu.

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY

At a recent meeting of the Radiological Society of Greater Kansas City, the following new officers were elected: President, Lewis G. Allen, M.D.; Kansas City, Kans.; Secretary, Samuel B. Chapman, Jr., M.D., 830 Argyle Bldg., Kansas City, Mo. Meetings are held the last Friday of each month.

WEST VIRGINIA RADIOLOGICAL SOCIETY

The West Virginia Radiological Society, meeting in conjunction with the West Virginia State Medical Society on Aug. 22, 1958, elected the following officers: President, W. Paul Elkin, M.D., Charleston; Vice-President, John D. H. Wilson, M.D., Clarksburg; Secretary-Treasurer, Karl J. Myers, M.D., 112 N. Woods St., Philippi, W. Va.; Member of the Executive Committee, H. A. Shaffer, M.D., Morgantown; Councilor to the American College of Radiology, John D. H. Wilson, M.D.; Alternate Councilor, J. L. Curry, M.D., Wheeling.

COURSE IN PEDIATRIC RADIOLOGY UNIVERSITY OF MINNESOTA

The University of Minnesota announces a continuation course in Pediatric Radiology for radiologists to be held Nov. 3 to 7, 1958, in the Mayo Memorial Auditorium in the University of Minnesota Medical Center. Guest participants will include Drs. James B. Arey, Temple University School of Medicine; John Caffey, Columbia University College of Physicians and Surgeons; Sidney Farber, Harvard Medical School; Robert A. Garrett, Indiana University School of Medicine; C. John Hodson, University College Hospital, London, England; A. S. Johnstone, General Infirmary, Leeds, England; John A. Kirkpatrick, Jr., Temple University School of Medicine; Edward B. D. Neuhauser, Harvard Medical School; Frederic N. Silverman, Children's Hospital, Cincinnati; E. F. Van Epps, State University of Iowa College of Medicine, Iowa City.

The Course will be presented under the direction of Drs. Harold O. Peterson, Richard G. Lester, and Samuel B. Feinberg, of the Department of Radiology of the University. The faculty will include also members of the faculty of the University of Minnesota Medical School and the Mayo Foundation.

Lodging and meal accommodations are available at the Center for Continuation Study.

NATIONAL BUREAU OF STANDARDS NEW RADIATION HANDBOOK

The National Bureau of Standards announces the publication of *Handbook 65: Safe Handling of Bodies Containing Radioactive Isotopes (A Guide for Surgeons, Pathologists, and Funeral Directors)*. This new handbook is a modified version of *Handbook 56: Safe Handling of Cadavers Containing Radioactive Isotopes*, published in 1953. It includes new information and revised permissible dose levels. Two appendixes offer: (1) an acceptable form for a radioactivity report accompanying the body; (2) a method of dosage calculation.

Copies of the publication may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., at a cost of 15 cents each.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

PRINCIPLES OF RADIOGRAPHIC EXPOSURE AND PROCESSING. By ARTHUR W. FUCHS. Second edition. A volume of 284 pages, with 159 figures and 25 tables. Published by Charles C Thomas, Springfield, Ill., 1958. Price $10.50.

ROENTGEN-DIAGNOSTICS. PROGRESS VOLUME I. By H. R. SCHINZ, R. GLAUNER, AND E. UEHLINGER. With the collaboration of W. E. Baensch, J. E. W. Brocher, U. Cocchi, R. Glocker, W. Hess, R. Janker, O. Norman, R. Prévot, G. Schoch, E. Uehlinger, S. Welin, J. Wellauer, E. Zdansky. Translated from the German by James T. Case, M.D., D.M.R.E. (Cambridge). A volume of 624 pages, with 545 figures containing 892 illustrations. Published by Grune & Stratton, Inc., New York 16, N. Y., 1958. Price $35.00.

THE PRACTICE OF NUCLEAR MEDICINE. By WILLIAM H. BLAHD, M.D., Chief, Radioisotope Service, Veterans Administration Center, Los Angeles, California; Assistant Clinical Professor of Medicine, School of Medicine, and Medical Physics Physician, Radiological Safety Division, University of California at Los Angeles; FRANZ K. BAUER, M.D., Chief, Outpatient Services, Los Angeles County Hospital; Associate Clinical Professor of Medicine and Co-ordinator of Radioisotope Research, University of Southern California School of Medicine; Associate Clinical Professor of Medicine, College of Medical Evangelists School of Medicine; Attending Specialist, Radioisotope Service, Veterans Administration Center, Los Angeles, Calif.; and BENEDICT CASSEN, Ph.D., Chief, Medical Physics Section, Atomic Energy Project and Clinical Professor of Biophysics, University of California at Los Angeles School of Medicine; Consultant in Radioisotopes, Radioisotope Service, Veterans Administration Center, Los Angeles, Calif. Introduction by Paul Aebersold, Ph.D., Assistant Director for Isotopes and Radiation, Division of Civilian Application, United States Atomic Energy Commission. Foreword by Joseph F. Ross, M.D., Associate Dean, Professor of Medicine and Radiology, School of Medicine, University of California at Los Angeles. A volume of 408 pages, with 113 figures. Published by Charles C Thomas, Springfield, Ill., 1958. Price $12.50.

HEMOPHILIC ARTHROPATHIES. By HENRY H. JORDAN, M.D., Orthopaedic Surgeon, Lenox Hill Hospital, Chief of Hemophilia Clinic, Lenox Hill Hospital, O.P.D., New York City, Consulting Orthopaedic Surgeon, Manhattan State Hospital, Orthopaedic Surgeon, National Hemophilia Foundation. A volume of 256 pages, with 64 figures. Published by Charles C Thomas, Publisher, Springfield, Ill., 1958. Price $8.50.

RADIATION PROTECTION. By CARL B. BRAESTRUP, Director, Physics Laboratory, Francis Delafield Hospital, Associate, Department of Radiology, Columbia University, New York, N. Y., Member, Executive Committee, National Committee on Radiation Protection and Measurements, and HAROLD O. WYCKOFF, Chief, Radiation Physics Laboratory, National Bureau of Standards, Washington, D. C., Secretary, International Commission on Radiological Units and Measurements. A volume of 362 pages, with figures and tables. Published by Charles C Thomas, Springfield, Ill., 1958. Price $10.50.

RESEARCH ON POWER FROM FUSION AND OTHER MAJOR ACTIVITIES IN THE ATOMIC ENERGY PROGRAMS, JANUARY–JUNE 1958. By UNITED STATES ATOMIC ENERGY COMMISSION. A volume of 410 pages, with figures, charts, and tables. Published by United States Government Printing Office, Washington, D. C., 1958. For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price, paper-bound, $1.25.

THE YEAR BOOK OF CANCER (1957–1958 YEAR BOOK SERIES). Compiled and edited by RANDOLPH LEE CLARK, JR., B.S., M.D., M.Sc. (Surgery), D.Sc. (Hon.), Houston, Texas, Director and Surgeon-in-Chief, The University of Texas M.D. Anderson Hospital and Tumor Institute; Professor of Surgery, The University of Texas Postgraduate School of Medicine; Clinical Professor of Surgery, Baylor University College of Medicine; Fellow, American College of Surgeons, and RUSSELL W. CUMLEY, B.A., M.A., Ph.D., Houston, Texas, Director of Publications, The University of Texas M.D. Anderson Hospital and Tumor Institute; Professor of Medical Journalism, The University of Texas Postgraduate School of Medicine. A volume of 524 pages, with 191 figures. Published by The Year Book Publishers, Inc., Chicago 11, Ill., 1958. Price $8.00.

ANNUAL REPORT ON THE RESULTS OF TREATMENT IN CARCINOMA OF THE UTERUS. ELEVENTH VOLUME: STATEMENTS OF RESULTS OBTAINED IN 1951 AND PREVIOUS YEARS (COLLATED IN 1957). Sponsored by American Cancer Society, British Empire Cancer Campaign, Cancerföreningen, Stockholm, Damon Runyon Memorial Fund, New York, Landsforeningen mot Kreft, Oslo, National Cancer Institute of Canada, Œuvre Nationale Belge de Lutte contre le Cancer. Editorial Committee: Dr. H.-L. Kottmeier (Editor), Stockholm, Dr. J. B. Blaikley, London, Dr. H. Martius, Göttingen, Dr. Joe V. Meigs, Boston, Phil. Dr. C.-O. Segerdahl, Stockholm. A monograph of 266 pages, with charts and tables. Published by Kungl. Boktryckeriet. P. A. Norstedt & Söner, Stockholm, 1958. Available on application from Editorial Office of Annual Report, Radiumhemmet, Stockholm 60, Sweden.

HANDBUCH DER TUBERKULOSE IN FÜNF BÄNDEN. Edited by Prof. Dr. J. HEIN, Direktor des Krankenhauses Tönsheide/Holstein, Prof. Dr. h. c. H. KLEINSCHMIDT, ehemals Direktor der Kinderklinik der Universität Göttingen, Honnef, and Prof. Dr. E. UEHLINGER, Direktor des pathologischen Instituts der Universität Zürich. BAND I: ALLGEMEINE GRUNDLAGEN. Bearbeitet von H. Bloch, Pittsburgh, Pa., P. Cohrs, Hannover, K. Diehl, Bad Schwalbach, H. G. Fassbender, Mainz, E. Hedvall, Uppsala, W. Herrmann, Essen, H. Kleinschmidt, Honnef, W. Löffler, Zürich, A. Ott, Solothurn, F. Redeker, Godesberg-Mehlem, F. E. Schmengler, Bad Reichenhall, F. Schmid, Heidelberg, E. Suter, Gainesville, Florida. A volume of 832 pages, with 244 figures. Georg

Thieme Verlag, Herdweg 63, (14a) Stuttgart, Germany, 1958. Price DM 178.—($42.40); by subscription DM 142.40—($33.80).

DERMATOLOGIE UND VENEROLOGIE: EINSCHLIESSLICH BERUFSKRANKHEITEN, DERMATOLOGISCHER KOSMETIK UND ANDROLOGIE IN FÜNF BÄNDEN. Edited by Prof. Dr. Dr. h. c. H. A. GOTTRON, Direktor der Universitäts-Hautklinik Tübingen, and Prof. Dr. Dr. h. c. W. Schönfeld, Direktor der Universitäts-Hautklinik Heidelberg. BAND II/TEIL 1: PHYSIKALISCHE BEHANDLUNG, DERMATOLOGISCHE KOSMETIK, KRANKHEITEN NOCH UNBEKANNTER HERKUNFT NACH IHRER MORPHOLOGIE. Bearbeitet von W. Blaich, Wuppertal-Elberfeld, et al. A volume of 758 pages, with 388 figures, some of which are in color. Published by Georg Thieme Verlag, Herdweg 63, (14a) Stuttgart, Germany, 1958. Price DM 173.—($41.20); by subscription DM 138.40 ($32.85).

Book Reviews

ROENTGENOLOGY OF THE CHEST. Edited by COLEMAN B. RABIN, M.D., F.C.C.P., Attending Physician and Associate Radiologist for Chest Diseases, The Mount Sinai Hospital, New York City; Assistant Clinical Professor of Medicine, College of Physicians and Surgeons, Columbia University; Consultant Physician for Chest Diseases, Veterans Administration, Brooklyn Regional Office and East Orange Hospital and Beth El Hospital, Brooklyn, New York. Editorial Committee: Benjamin M. Gasul, M.D., Burgess L. Gordon, M.D., J. Winthrop Peabody, Sr., M.D., Leo G. Rigler, M.D., Israel Steinberg, M.D., Harold G. Trimble, M.D. Sponsored by American College of Chest Physicians. A volume of 484 pages, with many roentgenograms. Published by Charles C Thomas, Springfield, Ill., 1958. Price $19.50.

This volume, with some fifty contributors, is sponsored by the American College of Chest Physicians, "to present roentgenology of the chest to the roentgenologist from the clinical standpoint, and to the clinician from the radiological point of view." There are chapters devoted to most of the diseases of the lungs and also to the congenital and acquired diseases of the heart and great vessels.

Owing to the wide range of subject matter and the large number of authors, there is bound to be a degree of unevenness in the text; in some instances the material is mostly clinical and in others chiefly roentgenologic. In general, however, the book fulfils the purpose for which it was designed and presents a large amount of useful information. It will be of interest and value to the chest physician and to the radiologist alike. One criticism would be that limitations of size made it impossible to explore thoroughly all aspects of such a large and complex field.

TUBERCULOSIS IN WHITE AND NEGRO CHILDREN. VOLUME I: THE ROENTGENOLOGIC ASPECTS OF THE HARRIET LANE STUDY. By JANET B. HARDY, M.D.C.M. A volume of 122 pages, with 227 roentgenograms, 12 photographs, and 21 line drawings. Published for the Commonwealth Fund by Harvard University Press, Cambridge, Mass.. 1958. Price $7.50.

TUBERCULOSIS IN WHITE AND NEGRO CHILDREN. VOLUME II: THE EPIDEMIOLOGIC ASPECTS OF THE HARRIET LANE STUDY. By MIRIAM E. BRAILEY, M.D., Dr.P.H. A volume of 103 pages, with 8 graphs and 39 tables. Published for the Commonwealth Fund by Harvard University Press, Cambridge, Mass., 1958. Price $4.50.

In 1928 the Harriet Lane Tuberculosis Clinic was established at the Johns Hopkins Hospital for a long-term study of tuberculosis in children. The data for these two companion volumes are derived for the most part from children treated in that Clinic.

The first volume is essentially an atlas of cases. Groups of illustrations representative of the radiographic findings in all types of childhood tuberculosis are accompanied by concise histories giving the significant clinical findings. In some instances the results following chemotherapy are illustrated.

Except for these case histories, the text is relatively brief. The anatomy of the lungs and the general principles of film interpretation are discussed, and there is a chapter describing the technic of bronchoscopy and bronchography.

The emphasis in the second volume is clinical. Section One deals with the prognosis of primary tuberculous infection in children, while Section Two discusses the risk of the development of reinfection pulmonary tuberculosis in this early age group. These studies predated the discovery of antimicrobial therapy for tuberculosis.

These books are of especial value to pediatricians and all concerned with the care of children suffering from tuberculosis. Volume I will appeal more strongly to the radiologist.

ACTION OF RADIATION ON TISSUES: AN INTRODUCTION TO RADIOTHERAPY. By A. LACASSAGNE, Chief of Service of Pasteur Institute, Director of the Radium Institute (Biological and Therapeutic Sections), and G. GRICOUROFF, Chief of the Laboratory of the Curie Foundation (Radium Institute). Second edition translated by Clarence C. Lushbaugh, M.D., and Gretchen R. Riese, M.S., Los Alamos Scientific Laboratory, University of California. A volume of 200 pages, with 17 figures. Published by Grune & Stratton, Inc., New York and London, 1958. Price $6.25.

Although this book is ostensibly a translation of the second edition of Lacassagne and Gricouroff's work on radiation effects, it bears the title of the first edition rather than that which the authors felt more

appropriate for the increased breadth and extent of their later revision, namely," The Action of Ionizing Radiation on the Body." A Foreword is supplied by Dr. Juan A. del Regato. For a review of the French original the reader is referred to RADIOLOGY **68**: 430, 1957.

WESEN UND BEDEUTUNG DER ENCHONDRALEN DYSOSTOSEN. By Privatdozent Dr. med. HANS MAU, Heidelberg. With a Foreword by Prof. Dr. K. Lindemann, Heidelberg. A monograph of 220 pages, with 83 figures. Published by Georg Thieme Verlag, Herdweg 63, (14a) Stuttgart, Germany, 1958. Distributed in the United States and Canada by Intercontinental Medical Book Corporation, New York 16, N. Y. Price DM 27.—($6.40).

In the term "enchondral dysostoses," the author seeks to embrace all the congenital disturbances of the development of cartilage into bone. He is making an attempt to clarify the confusing nomenclature and to identify certain guiding landmarks to overcome existing uncertainties. The classical chondrodystrophy is rather well defined, but it represents only a small entity in this large group in which atypical cases are many times more numerous than the typical.

The author follows the lead of Knoetzke, dividing the disturbances of ossification into two groups: first, the subperiosteal, also called metaphyseal, such as typical chondrodystrophic dwarfism; second, the subchondral, or epiphyseal, such as dwarfism with predominantly spinal changes ("Wirbelsäulenzwerg," "spinal dwarf"). Various grades of transition exist, however, and the mixed and atypical forms are again much more common than the typical ones. In the minor cases, which present few x-ray findings, the enchondral dysostosis is probably the basis for a defective skeletal system that may later lead to aseptic necrosis, localized arthritis, etc. The most sensitive roentgen sign of enchondral dysostosis is a delay in the appearance of the ossification centers on the x-ray film, particularly if there is also a dissociation in their appearance, *i.e.*, if they do not appear in their proper sequence. The contribution of enchondral dysostosis to many known entities such as Hurler's disease, cleidocranial dysostosis, osteogenesis imperfecta, chondromatosis, dyschondroplasia, arachnodactyly, acromicria, and others is discussed.

The book is divided into two sections. The first part describes the various disturbances in general. The influence of exogenous factors, such as trauma, excessive use, etc., and of endogenous conditions is evaluated. Concomitant diseases, such as rickets, nutritional disturbances, blood dyscrasias and their role in the production of the deformities are discussed. In the second, or special, section, the various anatomical parts of the body and their respective deformities are considered in detail and numerous well chosen films are reproduced. Particular attention is paid to the spine, the pelvis, and the hand.

The author's style is not easy, but he presents many thought-inspiring ideas and his book will surely be of value to the orthopedic surgeon, the radiologist, the pediatrician and, on account of the well described deformities of the pelvis, perhaps also to the obstetrician.

DIE VASKULÄREN ERKRANKUNGEN IM GEBIET DER ARTERIA VERTEBRALIS UND ARTERIA BASIALIS. EINE ANATOMISCHE UND PATHOLOGISCHE, KLINISCHE UND NEURORADIOLOGISCHE STUDIE. By H. KRAYENBÜHL, Professor für Neurochirurgie, Direktor der neurochirurgischen Universitätsklinik Zürich, and M. G. YAŞARGIL, Assistent der neurochirurgischen Universitätsklinik Zürich. Fortschr. a. d. Geb. d. Röntgenstrahlen, Ergänzungsband 80. A volume of 170 pages, with 205 illustrations (mostly roentgenograms) and many tables. Published by Georg Thieme Verlag, Herdweg 63, (14a) Stuttgart, Germany, 1957. Distributed in the United States and Canada by the Intercontinental Medical Book Corporation, New York 16, N. Y. Price DM 77.—($18.35)

This description of the diseases of the vertebral and basilar arteries is based on 250 vertebral arteriograms, 500 carotid arteriograms, 100 cervical spine radiograms, 400 cerebellar sections, and 15 postmortem arteriograms. In addition the authors have reviewed the literature regarding vertebral arteriography up to the end of 1956. Cases involving the normal vessels, pathologic vessels in the posterior portion of the circle of Willis, unusual anastomoses, thromboses, saccular aneurysms, arteriovenous communications, and hemangioblastomas are summarized and compared with their own observations. Toward the better interpretation of their angiograms, they detail the neural anatomy, the recognized anatomic variants, and the anastomotic possibilities in a separate chapter. It is noted that gross variations from the normal are fortunately rare, while minor deviations are frequent; in general, however, all vascular deviation tends to follow a regular and predictable pattern. Moreover the structure of the pons, cerebellum, and medulla oblongata is remarkedly constant.

Since internal carotid angiography visualizes the posterior cerebral arteries in only 30 per cent of all attempts and infratentorial filling is rare, study of the posterior portion of the circle of Willis awaited the introduction of percutaneous vertebral arteriography. The chief limitation of the present approach lies in the technical difficulty of getting the needle point properly in the artery. The likelihood of poor roentgenograms due to poor filling of the blood vessels and difficulty of recognition of the arteries because of overlying shadows are further drawbacks.

The confusing bulbopontine syndromes are in-

structively analyzed in terms of arteriograms which show either nonfilling of the vessels or demonstrate the actual vascular occlusion itself. Although it is still not uniformly possible to correlate all the arteriograms with the varying clinical pictures, knowledge is rapidly progressing. Vertebral and basilar arterial occlusion does produce a diagnosable syndrome. Incidentally, the chief symptom-inducing vessel in slowly progressing disease is the posterior inferior cerebellar artery. In sudden occlusions, the clinical findings depend upon the region and the size of the infarction.

In the study of infratentorial saccular aneurysms, the cases culled from the literature are reviewed and correlated with 200 new examples. Aneurysms are particularly satisfying subjects in arteriography because of their characteristic roentgen appearance. Along with other vascular anomalies, arteriovenous fistulae, and developmental disorders of the blood vessels, these aneurysms are specifically described in terms of their localization for corrective surgery.

In the tumor field, the authors point out that for the first time hemangioblastoma can be diagnosed with reasonable accuracy. The use of vertebral arteriography is as yet ineffective in demonstrating intracerebellar and intrapontine hemorrhage. Experience is also limited in instances of epidural and subdural hematomata.

This book is written in easy, precise German. The illustrations are excellent and the diagrams are better than average. An extensive bibliography is arranged topically. There is no index.

LES TUMEURS MALIGNES DE L'OREILLE (OREILLE INTERNE EXCLUE). By J. LEROUX-ROBERT AND A. ENNUYER, Fondation Curie, Institut du Radium de l'Université de Paris. A volume of 336 pages, with 122 figures. Published by Librairie Arnette, 2, rue Casimir-Delavigne, Paris, France, 1957.

This is an excellent book dealing with all types of tumors (primary and metastatic) of the ear. As in other publications in which Dr. Ennuyer has had a part, there is a thorough, orderly, well documented account of every aspect of the subject. The study is based on 235 cases of cancer of the pinna, 8 cases of cancer of the external auditory canal, and 17 of the middle ear, collected from the records of the Curie Foundation. To this material have been added the information gathered from inquiries made to well known radiotherapists and otologists all over the world and data collected from the literature since 1925.

The book is well organized and packed with useful information presented in numerous tables, permitting an easy analysis of sites, incidence, symptoms, cervical and distant metastases and their correlation with therapy and ultimate results. Since a surgeon and a radiotherapist who have worked together for many years have collaborated in the authorship, there is a refreshing freedom from prejudice in favor of one or the other form of therapy. Both surgical and radiotherapeutic technics are described for all tumor types.

The work is divided into four parts. The first two deal, respectively, with the epithelial tumors of the pinna and of the external auditory canal and middle ear. The third part covers a variety of subjects, including sarcomas, melanomas, lymphomas, glomus tumors, and other rare growths of the ear; hemopathies and bone marrow tumors in the ear; extensions to the external and middle ear from adjacent tumors; metastatic lesions of the temporal bone. Finally, Part IV is devoted to the radiological diagnosis of the malignant tumors of the temporal bone. A comparative table of the results from the Curie Foundation and those published in the literature completes the study of each group of tumors.

The authors believe that radiotherapy alone is frequently indicated, especially in the cancers of the pinna. The indications for surgery, either alone or combined with radiation, increase with the depth of tumor invasion. The belief is expressed that the results in deep-seated tumors will improve with the use of supervoltages and bolder surgery. Stress is also laid upon early diagnosis in the tumors of the middle ear in order to improve results. The high incidence of squamous-cell carcinomas of the middle ear in long standing infections is pointed out, as well as the importance of close follow-up, including exfoliative cytology to detect early cancer.

The chapter on radiological diagnosis of cancer of the temporal bone is illustrated with numerous reproductions of films, including tomograms.

This book is probably the most complete and best documented work in existence on malignant neoplasms of the ear and will, no doubt, serve for many years as a reference book for specialists in this field.

LA BRONCOGRAFIA. By L. DI GUGLIELMO, Istituto di Radiologia dell'Università di Pavia, L. PIGORINI, Istituto "C. Forlanini" Clinica Tisiologica dell'Università di Roma, AND G. A. CITRONI, Clinica Otorinolaringoiatrica dell'Università di Pavia. A volume of 676 pages, with 621 figures, mostly roentgenograms. Published by "Il Pensiero Scientifico"—Editore, Via Brenta, 13, Rome, Italy, 1957. Price L. 15,000.

This book, the product of collaboration between two radiologists from two universities and an otorhinolaryngologist, is a masterpiece of completeness in text and illustrations. It is based on 4,000 cases collected over many years. The account of bronchographic technic is superb, and the reproductions are among the finest published anywhere. The text is clear and the illustrations are supplied with informative captions.

The book is divided into three parts. The first, comprising ten chapters, covers contrast media,

technic, anesthesia, complications of the procedure, and the anatomy and physiology of the bronchial tree. The second part covers in eight chapters the appearance of the normal and abnormal bronchogram. The third part, which is the best and largest portion of the book, includes twenty-eight chapters. It deals in detail with the multiple pathologic conditions demonstrated and studied by bronchography. The conditions covered include congenital anomalies, inflammatory and neoplastic diseases, parasitic infestation, pneumoconiosis, foreign bodies, trauma to the bronchi, and fistulas. In the last six chapters of the work the authors discuss effects on the bronchogram attributable to diseases of the mediastinum, pleura and chest wall, as well as postoperative and postirradiation changes and those incident to collapse therapy. Some of the illustrations such as those of tuberculosis and bronchial adenoma stand out even in this wealth of excellence.

A translation of this work for the benefit of English-speaking physicians would be highly desirable. It is a classic in an important field.

LA BRONCOGRAFIA NELLA FISIOPATOLOGIA BRONCHIALE. By DARIO GANDINI AND GIOVANNI JULIANI. With a foreword by Prof. Enrico Benassi. A volume of 190 pages, with 147 figures. Published by Edizioni Minerva Medica, Turin, Italy, 1957. Price 4,000 lire.

This small book is an interesting attempt to study bronchograms with respect to the movements of the bronchial tree. The book is divided into four parts. The first deals with the technic of study of bronchial motility by means of bronchography, the second discusses the physiology of tracheobronchial motility, and the third describes the normal movements of the bronchi. It is in this third part that an extensive discussion of motility as seen by bronchography is given. Displacements of the trachea and the bronchi during respiration are described, as well as the changes in their caliber and length. In the last part, comprising 10 chapters (80 pages), alterations in bronchial motility in asthma, emphysema, chronic bronchitis, bronchiectasis, bronchial stenosis, pulmonary tuberculosis, pneumoconiosis, and adhesive pleuritis are analyzed.

The book gives a considerable amount of research data and interesting physiopathologic information. While most of the material presented is of theoretical importance today, it is quite likely that, with the emphasis on early detection of disease, practical application of this method may become popular in the not too distant future.

RADIOTERAPIA MODERNA. By F. WACHSMANN, G. BARTH, AND S. DI RIENZO. A volume of 314 pages, with 129 figures and 6 tables. Published by Editorial Assandri, Dean Funes 61, Córdoba, Argentina, 1957.

Up until the publication of *Radioterapia Moderna*, radiotherapists have replied to their residents' most common question: "Where can I find a compendium giving the proper dose of radiation for each disease?" by saying: "There is no such book, my son, you must learn from experience. Always remember that there are not diseases, but patients."

Now, in *Radioterapia moderna* the authors have provided, in 300 pages, not only the basic foundations of physics and radiobiology but a complete manual of treatment of benign and malignant diseases by means of all types of radiations including Chaoul, grid, and all modalities of moving-beam therapy.

For the resident and the hurried practitioner there are neat tables at the end of each chapter giving the indications for treatment, and retreatment, together with the physical factors, the fields, and the daily and total dose. The major defect of such tables is that they embody the temptation to use them as a substitute for experience. Radiotherapy cannot be reduced to a series of tables any more than internal medicine can be summarized by a formulary of drugs.

There are a number of points to which exception might be taken by most radiotherapists. These include employment of the Chaoul technic for melanomas, sarcomas, and cancer of the colon and rectum, the use of radiation for painful socket following tooth extraction, the treatment of pneumonia in children, and the moving-beam technic for inoperable cancer of the stomach.

The analysis of supervoltage, heavy-particle radiation and isotopes, is of necessity preliminary in nature and does not include many of the more recent advancements in these fields.

The last chapter gives a good review of the achievements and pitfalls of fifty years of radiotherapy. One of the last sentences should be printed in bold type:

"*Roentgen therapy is a medical specialty which requires a thorough and intense training plus a continuous effort toward its progress.*"

FORTY-THIRD ANNUAL MEETING: COMMERCIAL EXHIBITS

The Commercial Exhibits Section constitutes a most important part of the Annual Meeting of the Radiological Society, bringing together in imposing array advances in equipment, media, protective devices, procedure, publications, etc. The following list of exhibits to be presented at the 1958 Meeting has been assembled by the Committee on Exhibits (Dr. John H. Gilmore, Chairman) as a guide for those planning to attend.

ABBOTT LABORATORIES, North Chicago, Ill. (Booth 108).

ANSCO, DIVISION OF GENERAL ANILINE & FILM CORPORATION, Binghamton, N. Y. (Booths 16 and 17): Ansco will feature an improved High-Speed X-ray Film (screen-type) having significant characteristics of real interest to all radiologists. In addition, announcement will be made of the availability of Ansco X-ray Films in new type packages providing better utility. These two introductions will be supplemented with a display of Non-Screen and High-Speed Monopak Films, as well as various practical aids, calculators, booklets, and charts.

ATLANTIC MICROFILM, Pearl River, N. Y. (Booth 88).

ATOMIC ENERGY OF CANADA, LTD., Ottawa, Canada. (Booths 67 and 68): Featured at the Atomic Energy of Canada exhibit will be two new cobalt-60 teletherapy units: The "Theratron F"—a highly flexible rotational apparatus—will be represented by a large-scale working model demonstrating its unique features. A stationary version of this unit for fixed beam applications, the "Eldorado Super G," utilizing the same high capacity treatment head, will be available for actual demonstration.

A professional staff will be on hand to reply to inquiries concerning equipment of this nature, Cobalt 60, and other radioisotope applications to medicine.

THE AUTOMATIC SERIOGRAPH CORPORATION, College Park, Md. (Booth 107): The Automatic Seriograph Corporation, a subsidiary of Litton Industries, Inc., will exhibit the Model 110 Automatic Seriograph, a rapid-sequence cassette changer which works in conjunction with standard x-ray equipment. The Seriograph will automatically take up to twelve 11 × 14″ roentgenograms at preselected interval speeds of one-half second to over two seconds. It is especially designed for cerebral angiography, angiocardiography, and any other study requiring a series of x-ray pictures at regular or irregular intervals.

BARNES-HIND BARIUM PRODUCTS CO., Sunnyvale, Calif. (Booth 38): Barnes-Hind Barium Products Co. will exhibit Barotrast, the most widely accepted barium medium for use in routine gastrointestinal examinations. This product has demonstrated itself over the past five years to be of exceptional help for routine studies and has enabled the radiologist to be assured of exact results in such difficult technics as double-contrast colon studies.

The Pneumocolon, a unique device for the administration of Barotrast or air in colon studies, will also be demonstrated.

BAR-RAY PRODUCTS, INC., Brooklyn, N. Y. (Booths 105 and 106): Bar-Ray's exhibit features the new Royal line of processing tanks faced with formica and incorporating the very latest in high-speed x-ray film processing facilities. The formica exteriors forestall rusting and discoloration, and a wide selection of colors is available to match the dark-room *decor*.

Also featured will be a piece of high-density lead glass 8″ thick. This glass has unusual clarity and the exhibit is designed to show the viewing area obtained. The new styled coated Archer cloth will also be demonstrated.

BELL-CRAIG, INC., New York, N. Y. (Booth 13).

BROWN-FORMAN INDUSTRIES, Louisville, Ky. (Booths 62 and 63).

BUCK X-OGRAPH COMPANY, St. Louis, Mo. (Booths 91 and 92).

CARR CORPORATION, Culver City, Calif. (Booths 24 and 25): Carr Corporation will exhibit their new automatic processing equipment which uses hangers. This new unit is completely fabricated from stainless steel and is able to process film, dry to dry, in approximately twelve (12) minutes. The list price is $9,900.00. On exhibit also will be a developing tank which has the plumbing in the front.

COCA COLA COMPANY, Atlanta, Ga. (Booth 7).

CONTINENTAL X-RAY CORPORATION, Chicago, Ill. (Booths 114 and 115).

CORECO RESEARCH CORPORATION, New York, N. Y. (Booth 101): The Coret Camera to be shown by Coreco Research Corporation embodies the prin-

ciple of electronic flash and constant automatic control of such factors as distance, aperture, field, and exposure. Now, for the first time, Coreco offers a completely automatic professional clinical camera designed to achieve the ultimate in surface, intra-oral, and intra-tubular photography. Because of the simplicity of operation, even an inexperienced physician or nurse can achieve consistently perfect color transparencies.

DUNLEE CORPORATION, Chicago, Ill. (Booth 83): Dunlee Corporation will feature their new Bifocus housing, together with a complete line of rotating anode housings, including a new and modern undertable unit. A variety of tube inserts and valve tubes will also be on display.

E. I. DU PONT DE NEMOURS & COMPANY, Wilmington, Del. (Booths 57–60).

EASTMAN KODAK COMPANY, Rochester, N. Y. (Booths 97–98, and 109–110).

EUREKA X-RAY TUBE CORP., Chicago, Ill. (Booth 76): The RA-79 and RA-90 units for high-voltage radiography, together with the popular RA-71 100-kvp units will be displayed by Eureka X-Ray Tube Corporation. The RA-79 and the RA-90 units operate to 125 kvp. High-voltage radiographic technics made practical by these tubes reduce radiation to the patient.

A select grouping of x-ray tubes and valves for medical and industrial applications will also be shown.

FORSYTH X-RAY CORPORATION, Chicago, Ill. (Booth 27).

E. FOUGERA AND COMPANY, INC., Hicksville, N. Y. (Booth 82): The new oral cholecystographic contrast medium, Orabilex, will be presented in a pseudo-scientific exhibit describing experience in over 1,000 procedures. Orabilex provides one standard dosage for all patients, eliminates costly repeat studies, avoids confusing intestinal opacities, increases diagnostic accuracy, and presents fewer side-effects than any other medium. Samples and literature will be available.

FRANKLIN X-RAY CORPORATION, Philadelphia, Penna. (Booth 100).

GENERAL ELECTRIC COMPANY, Milwaukee, Wisc. (Booths 30–36).

GORDON CONSULTANTS, New York, N. Y. (Booth 45): Gordon Consultants are showing:

(1) Latest model Gordon full-size x-ray projector, with interchangeable lenses for both long and short distances; high and low projection; improved smaller head to minimize obstruction; 750,000 candle power. Other advantages are coolness, noiselessness, easy transportability, brightness up to three times that of previous Gordon models, better definition and twice light-box brightness.

(2) Shutter attachment for light boxes which brings out dimly visible details at a distance.

(3) Vest-pocket stereoscope, standard for U. S. Armed Forces.

GRUNE & STRATTON, INC., New York, N. Y. (Booth 40): Mr. Frank Kurzer will welcome you to Booth 40, where you may examine such recent books as: Lacassagne and Gricouroff's *Action of Radiation on Tissue;* Buschke's *Progress in Radiation Therapy;* Schinz, Glauner, and Uehlinger's *Roentgen-Diagnostics: Progress Volume* I (1952–1957); Lassrich, Prévôt, and Schäfer's *Pediatric Roentgenology;* Clark's *Positioning in Radiography,* seventh edition; Storch's *Fundamentals of Clinical Fluoroscopy,* second revised edition; Snapper's *Bone Disease in Medical Practite;* Böhler's *The Treatment of Fractures,* Volume III; and many other books essential for your daily practice.

HALSEY X-RAY PRODUCTS, INC., Brooklyn, N. Y. (Booths 102-103): Attending Booths 102 and 103 will be two of Halsey's new regional sales managers, who will have a remarkable new diagnostic device to discuss with you. This device is a first in the history of the industry. Its value is manifest. Please stop in, see it, and leave us your impression.

Of course, the excellent accessory line will be exhibited in part, with some new ideas and some new products.

HIGH VOLTAGE ENGINEERING CORPORATION, Burlington, Mass. (Booth 93).

PAUL B. HOEBER, INC., Medical Book Department of Harper & Brothers, New York, N. Y. (Booth 44): At the Paul B. Hoeber booth may be seen the first three volumes of the completely new second edition of *The Treatment of Cancer,* edited by Pack and Ariel: Vol. 1. Principles of Treatment; Vol. 2. Tumors of the Nervous System; Vol. 3. Tumors of the Head and Neck. Among other new publications of special interest are the second edition of Homburger-Fishman's *Physiopathology of Cancer;* Milch and Milch's *Common Fractures: Their Recognition and Treatment;* Dalsace and Garcia-Calderon's *Gynecologic Radiography.* Details of Paul and Juhl's forthcoming *Essentials of Roentgen Interpretation* will be available. You are cordially invited to browse at leisure among the books and journals published by Hoeber-Harper.

HOWDON VIDEX PRODUCTS CORPORATION, Mount Vernon, N. Y. (Booth 64).

ILFORD, INC., New York, N. Y. (Booth 12).

INFO-DEX CANCER REGISTRY SYSTEM, Medical Case History Bureau, New York, N. Y. (Booth 60A): Devised in collaboration with the Statistical Department of the American Cancer Society, the Info-Dex Cancer Registry System meets the requirements of the American College of Surgeons. This cancer registry includes *all* vital information

in *one* file and requires no trained personnel to maintain it. The System is compact, efficient, and inexpensive.

THE INTERNATIONAL MEDICAL RESEARCH CORPORATION, New York, N. Y. (Booth 50): The International Medical Research Corporation will show the new Satellite Combination Therapy Unit, which bridges the gap a radiologist usually has in his office as far as therapy is concerned; stepless kv control, from 5 to 140 depth dosage. This represents an intermediary unit, beryllium window superficial therapy unit, contact and grenz ray apparatus. The output is 40,000 r per minute, with as much as 17 r at the skin with a target-skin distance of 200 cm.

KELEKET CORPORATION, Waltham, Mass. (Booths 120-122).

LEA & FEBIGER, Philadelphia, Penna. (Booth 15): Lea & Febiger urge you to see Epstein's *Clinical Radiology of Acute Abdominal Disorders;* Quimby, Feitelberg and Silver's *Radioactive Isotopes in Clinical Practice;* Jaffe's *Tumors and Tumorous Conditions of the Bones and Joints;* Ritvo's *Chest X-Ray Diagnosis* and *Bone and Joint X-Ray Diagnosis;* Ritvo and Shauffer's *Gastrointestinal X-Ray Diagnosis;* Epstein's *The Spine;* Epstein and Davidoff's *Atlas of Skull Roentgenograms;* Davidoff and Epstein's *The Abnormal Pneumoencephalogram;* Holmes and Robbins' *Roentgen Interpretation;* Rhinehart's *Roentgenographic Technique;* Pohle's *Clinical Radiation Therapy;* Ennis' *Dental Roentgenology;* and many other valuable texts.

LEISHMAN X-RAY ENGINEERING COMPANY, Los Angeles, Calif. (Booths 95-96).

LIBERTY PROTECTIVE LEATHERS, INC., Gloversville, N. Y. (Booth 84).

THE LIEBEL-FLARSHEIM COMPANY, Cincinnati, Ohio. (Booth 99).

LOGETRONICS, INC., Alexandria, Va. (Booths 116 and 117).

LOW X-RAY FILM CORPORATION, New York, N. Y. (Booths 51 and 52): Low X-Ray Film Corporation, exclusive distributors of Gevaert Blue Base Medical X-Ray Film, cordially invites you to visit its display and ask their representatives about these new Gevaert Products: Gevaert Ultra Speed Film, which permits sharp reduction in exposure, fine definition, excellent contrast, regular processing; Gevaert Hi-kv Film (Curix H) for use where 125-kv technics are preferred, with low fog level, greater contrast, higher gamma; Gevaert Non Screen Film individually wrapped in light-proof envelopes, improved, faster-fixing.

Low X-Ray Film Corporation also distributes a complete line of processing chemicals and all x-ray accessories.

MACHLETT LABORATORIES, INC., Springdale, Conn. (Booths 111-112).

MALLINCKRODT CHEMICAL WORKS, St. Louis, Mo. (Booth 94).

MATTERN X-RAY DIVISION, Land Air, Inc., Chicago, Ill. (Booths 73-75).

DONALD MC ELROY, INC., Chicago, Ill. (Booth 29).

MEDICAL DENTAL PHOTO CO., Levittown, N. Y. (Booth 26).

MICRO X-RAY RECORDER, INC., Chicago, Ill. (Booth 119): The Micro X-Ray Recorder, a microfilming unit that will record x-rays, photographs, charts, EKG's, case histories, and specimens on a 100-foot roll of 35-mm. film, will be featured. Of special interest are its two-lens system and provision for lightening-up "over-exposed" films. The Micro X-Ray Recorder, PV-501 Projector-Viewer, Indexer, 35-mm. mounts, and other accessories, will also be shown. New series of 35-mm. Micro X-Ray Recorder Slides for lectures, teaching, and reference, are also featured.

MID-WEST GLOVE COMPANY, INC., Chicago, Ill. (Booth 79): Mid-West Glove Company is exhibiting Security x-ray protective gloves and aprons for the radiologist and for the many dealers who service the x-ray field. Of special interest are the new products for protection of patients: waist aprons for use during chest roentgenography, and other similar items. Another new development is a washable plastic covering on all aprons. Security x-ray gloves will be demonstrated in the new blue color, with emphasis on safety and comfort.

NATIONAL X-RAY PRODUCTS CORPORATION, Hackensack, N. J. (Office 402): National X-Ray Products Corporation will again exhibit and demonstrate their Spindex Ultra Rapid X-Ray Film Drying Machine. This all stainless-steel unit uses centrifugal force to spin-dry the film and can dry a full load of eighteen 14 × 17-inch films on conventional hangers in three minutes. No desiccants or chemicals are used and no nightly regeneration is necessary. The machine is very compact and needs no special wiring or plumbing.

NORTH AMERICA PHILLIPS COMPANY, INC., Mount Vernon, N. Y. (Booths 53-56).

NUCLEAR-CHICAGO CORPORATION, Chicago, Ill. (Booth 113): Nuclear-Chicago Corporation will show a complete line of radioisotope measuring and detection instruments for clinical studies. Complete counting systems for thyroid-uptake studies, blood-volume determinations, estimation of cardiac output, etc., will be demonstrated, and literature

explaining these diagnostic procedures will be available. Included in the exhibit will be a complete line of scalers, ratemeters, scintillation detectors, portable survey meters, and an exclusive medical instrument which combines a scaler, spectrometer and an automatic computing system in one compact chassis. A modern isotope scanning system with a photorecording attachment will also be demonstrated.

NUCLEAR CORPORATION OF AMERICA, St. Louis, Mo. (Booths 69-71).

NUCLEAR MEASUREMENT CORPORATION, Indianapolis, Ind. (Booths 62-63).

PAKO CORPORATION, Minneapolis, Minn. (Booths 41-43).

PELVIC ANCHOR CORPORATION, Rochester, N. Y. (Booth 66): The exhibit of Pelvic Anchor Corporation will be devoted to the general use of Vacuum Placement Cups in the department of radiography. Vacuum Placement Cups #407-S-D have a wider application than sandbags and are used as body supports for positioning patients, for holding lead shields and cassettes, and for various other applications. Similar units are used in surgery for applying traction on the general operating tables. A very practical unit to be added to the radiologist's armamentarium!

PHYSICIANS TECHNICAL EQUIPMENT CO., Milwaukee, Wisc. (Booth 104) will stress products and procedures instrumental in low-dosage radiography: (1) *Smit-Roentgen "Jewel 110,"* 110 line per inch stationary grid, ratios 10:1; 12 1/2:1; 15:1; 17 1/2:1, available as grids, grid cassettes and grid channels for conversion of conventional cassettes into grid cassettes; (2) *A U E R Simultan-Multisection Cassettes* for 3, 4 and 5 body-sections at 0.5- and 1-cm. film distance. These cassettes fit the conventional L-F Bucky of current planigraphic equipment; no modification of equipment required; (3) *P.T.E. Swinging Divider*, a new type film blocker, sequence marker, and grid holder; (4) *A U E R "Flash," "High Speed," and "Detail-Standard" Intensifying Screens;* (5) *A U E R "Ultraphan" Fluoroscopic Screens* with warning signal; (6) *Smit-Roentgen Heavy-Duty Light-Weight Cassettes; P.T.E. Single Lever Lock Light-Weight Cassettes.* High-kv low-dosage radiographs made with 110-line grids will be on display.

PICKER X-RAY CORPORATION, White Plains, N. Y. (Booths 18-23 and 77).

PROFEXRAY, INC., Maywood, Ill. (Booths 80-81).

RADIOLOGY, Detroit, Mich. (Booth 125): Representatives from the Editorial Office of Radiology, the official organ of the Radiological Society of North America, will be ready to point out the excellencies of the journal and discuss problems of publication, with suggestions as to the preparation of manuscripts, illustrations, bibliographies, etc. Copies of a recent issue will be available. Most important of all, orders will be taken for the new *Five-Year Index*, the fourth in the series of indexes covering in detail the contents of sixty-nine volumes (1923-1957) of RADIOLOGY. This new *Index* will be ready for distribution early in 1959.

RADIUM CHEMICAL CO., INC., New York, N. Y. (Booth 14).

SCHICK X-RAY CO., INC., Chicago, Ill. (Booth 65): The special feature of the Schick X-Ray Company exhibit will be *Koordinat*, a special fluoroscopic table for catheterization. This unit is designed for use with: Elema-Schönander film changers. A Bucky diaphragm can be added to the Koordinat for general radiographic work. Provisions are made to permit installation of an image intensifier with the Koordinat.

FRANK SCHOLZ X-RAY CORPORATION, Boston, Mass. (Booth 61).

SIEMENS NEW YORK INCORPORATED, X-Ray Division, New York, N. Y. (Booths 85 and 86): The Siemens Mobile Image Intensifyer to be seen in Booths 85 and 86 has been designed, primarily, for use in the operating room but lends itself to numerous purposes. It comprises an x-ray unit of adequate and variable output, suitable for fluoroscopy and limited radiography, and an intensifier incorporating several unique features. Noteworthy are its mobility, flexibility, and simplicity of operation.

E. R. SQUIBB & SONS, New York, N. Y. (Booth 37).

STANDARD X-RAY COMPANY, Chicago, Ill. (Booths 8–11): The Standard X-Ray Company will exhibit and demonstrate the newly designed combination radiographic and fluoroscopic table. The newly developed mobile x-ray unit will also be shown. Attendants will be most pleased to demonstrate apparatus on exhibit and supply any information desired.

THURESSON & ANGRAEIGHT, Skokie, Ill. (Office 403).

TRACERLAB, INC., Waltham, Mass. (Booths 123 and 124).

UNITED STATES RADIUM CORPORATION, Morristown, N. J. (Booth 72).

THE VICTOREEN COMPANY, Cleveland, Ohio. (Booth 90).

VOLK RADIOCHEMICAL COMPANY, Chicago, Ill. (Booth 39).

WESTINGHOUSE ELECTRIC CORPORATION, X-Ray Division, Baltimore, Md. (Booths 1–6): Westinghouse will exhibit for review and examination a

completely new medium-priced, heavy-duty radiographic-fluoroscopic unit. In addition, there will be displayed the Fluorex image intensifier with Cine recording equipment and other x-ray apparatus. All radiologists are invited to visit Booths 1–6 as often as possible during the week to enjoy a first-hand preview of the diagnostic equipment and learn about some of the advances Westinghouse has made in other x-ray equipment.

WILLIAMS & WILKINS COMPANY, Baltimore, Md. (Booth 87): Among the many books on radiology, related specialties, and the basic sciences on display by Williams & Wilkins Company will be the standard Golden's *Diagnostic Roentgenology;* Feldman's *Clinical Roentgenology of the Digestive Tract,* 4th edition; the new 4th edition of Appleton, Hamilton & Tchaperoff's *Surface and Radiological Anatomy;* the new Shy, Bradley and Matthews' *External Collimation Detection of Intracranial Neoplasia with Unstable Nuclides,* and Stirling's *Aortography.*

WINTHROP LABORATORIES, New York, N. Y. (Booth 28): Three of the newer radiopaque media will be featured by Winthrop Laboratories:

Telepaque: Highly effective and well tolerated oral cholecystopaque medium. Gives dense, clear-cut pictures of the gallbladder and, in a substantial number of cases, also permits visualization of the biliary ducts.

Hypaque Sodium: 50% sterile solution (ampuls of 30 c.c.), new well tolerated highly radiopaque medium for excretion urography, containing 59.87 per cent iodine. Produces excretory urograms of a clarity approaching that usually obtained by the retrograde method.

Hypaque M 90%: Concentrated solution of Hypaque sodium with Hypaque methylglucamine for angiocardiography, supplied in vials of 50 c.c. with dual-purpose caps (permitting withdrawal by needle as well as pouring).

WOLF X-RAY PRODUCTS, INC., Brooklyn, N. Y. (Booths 46–49).

X-RAY SOLUTION SERVICE, Detroit, Mich. (Booth 89): X-Ray Solution Service, a group of independent organizations located throughout the East and Midwest, will show the nature of the services each organization performs. Various graphic arts media will be employed to point out that these services go beyond supplying x-ray solutions and concentrates. They include complete tank maintenance service, low mas solutions, and a complete used film purchasing program.

YEAR BOOK PUBLISHERS, INC., Chicago, Ill. (Booth 118): The Year Book Publishers will present several new titles of particular interest to radiologists —Singleton's *X-Ray Diagnosis of the Alimentary Tract in Infants and Children,* Lusted and Keats' *Atlas of Roentgenographic Measurement,* Randall's *Elements of Biophysics,* the new *Year Book of Radiology,* the new 3rd Edition of Hodges, Lampe and Holt's *Radiology for Medical Students,* and Kjellberg's *Lower Urinary Tract in Children.* Other standard volumes, such as Caffey's *Pediatric Diagnosis,* will be available for inspection.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, Robert L. Brown, M.D., P. O. Box 459, Emory University, Ga.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, C. Allen Good, M.D., Rochester, Minn.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6.

ASSOCIATION OF UNIVERSITY RADIOLOGISTS. *Secretary-Treasurer*, Paul A. Riemenschneider, M.D., 736 Irving Ave., Syracuse 10, N. Y.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, T. Leucutia, M.D., 10 Peterboro, Detroit 1, Mich.

SOCIETY OF NUCLEAR MEDICINE. *Secretary*, Robert W. Lackey, M.D., 452 Metropolitan Bldg., Denver 2, Colo.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Garland Wood, Jr., M.D., Medical College of Alabama, Birmingham 3.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. Lee Foster, M.D., 1313 N. Second St., Phoenix. Annual meeting with State Medical Association; interim meeting in December.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, E. A. Mendelsohn, M.D., Holt-Krock Clinic, Fort Smith. Meets quarterly.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, William H. Graham, M.D., 630 E. Santa Clara St., San Jose.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker. M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, Robert B. Engle, M.D., St. Luke Hospital, Pasadena. Meets second Wednesday, September, November, March, April, and June, Los Angeles County Medical Association Building.

NORTHERN CALIFORNIA RADIOLOGICAL SOCIETY. *Secretary*, Rob H. Kirkpatrick, M.D., 1219 28th St., Sacramento 16. Meets last Monday of each month, September through June.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually at time of California State Medical Association convention.

RADIOLOGICAL SOCIETY OF SOUTHERN CALIFORNIA. *Secretary-Treasurer*, Harold P. Tompkins, M.D., 658 S. Westlake, Los Angeles 57.

REDWOOD EMPIRE RADIOLOGICAL SOCIETY. *Secretary*, Lee E. Titus, M.D., 164 W. Napa Street, Sonoma. Calif. Meets second Monday every other month.

SAN DIEGO RADIOLOGICAL SOCIETY. *Secretary*, Stanley A. Moore, M.D., 2466 First Ave., San Diego 1. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Irma Smith, M.D., 450 Sutter St., San Francisco 8. Meets quarterly, at Grison's Steak House.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, Stanford B. Rossiter, M.D., 1111 University Dr., Menlo Park. Meets second Wednesday every month.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, John H. Heald, M.D., 450 Sutter St., San Francisco 8. Meets third Thursday at 7:30 P.M., Children's Hospital, September through June.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Lorenz R. Wurtzebach, M.D., 601 E. Nineteenth Ave., Denver 5. Meets monthly, third Friday, at Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary-Treasurer*, Ralph J. Littwin, M.D., Bristol Hospital, Bristol. Meets bimonthly, second Wednesday.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary-Treasurer*, Charles E. Bickham, Jr., M.D., 1835 Eye St., N.W., Washington 6. Meets third Wednesday, January, March, May, and October, 8:00 P.M., in Medical Society Library.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Russell D. D. Hoover, M.D., 1717 N. Flagler Dr., West Palm Beach. Meets in April and October.

GREATER MIAMI RADIOLOGICAL SOCIETY, *Secretary-Treasurer*, George P. Daurelle, M.D., Jackson Memorial Hospital, Miami 36. Meets monthly, third Wednesday, 8:00 P.M., at Jackson Memorial Hospital.

NORTH FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Marvin Harlan Johnston, M.D., Five Points Medical Center, Jacksonville 4. Meets quarterly, March, June, September, and December.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Luther Clements, Jr., M.D., 35 Linden Ave., N.E., Atlanta 8. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Herbert M. Olnick, M.D., 417 Persons Bldg.,

Macon, Ga. Meets in November and at the annual meeting of the State Medical Association.

RICHMOND COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Wm. F. Hamilton, Jr., M.D., University Hospital, Augusta. Meets first Thursday of each month.

Hawaii

RADIOLOGICAL SOCIETY OF HAWAII. *Secretary-Treasurer*, Robert G. Rigler, M.D., 1020 Kapiolani St., Honolulu 14. Meets third Monday of each month.

Idaho

IDAHO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Charles R. McWilliams, M.D., Twin Falls.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary-Treasurer*, George B. Cahill, M.D., 802 Burns Ave., Flossmoor, Ill. Meets at the Sheraton Hotel, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Stephen L. Casper, M.D., Physicians and Surgeons Clinic, Quincy.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, William Meszaros, M.D., 1825 W. Harrison St., Chicago.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, Chester A. Stayton, Jr., M.D., 313 Hume Mansur Bldg., Indianapolis 4. Meets twice a year, first Sunday in May and during fall meeting of State Medical Association.

TRI-STATE RADIOLOGICAL SOCIETY (Southern Indiana, Northwestern Kentucky, Southeastern Illinois). *Secretary-Treasurer*, Robert E. Beck, M.D., 600 Mary St., Evansville, Ind. Meets last Wednesday, October, January, March, and May, 8:00 P.M., at the Elks' Club, Evansville, Ind.

Iowa

IOWA RADIOLOGICAL SOCIETY. *Secretary*, James T. McMillan, M.D., 1104 Bankers Trust Bldg., Des Moines. Meets during annual session of State Medical Society, and in the Fall.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary*, James R. Stark, M.D., 3244 East Douglas St., Wichita 8. Meets in the Spring with the State Medical Society and in the Winter on call.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert H. Akers, M.D., 1405 West Broadway, Louisville 3. Meets monthly, second Friday, at Seelbach Hotel, Louisville.

Louisiana

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets second Tuesday of each month.

RADIOLOGICAL SOCIETY OF LOUISIANA. *Secretary-Treasurer*, Seymour Ochsner, M.D., Ochsner Clinic, New Orleans 15.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, W. R. Harwell, M.D., 608 Travis St. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Francis J. O'Connor, M.D., Augusta General Hospital, Augusta. Meets in June, October, December, and April.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*, James K. V. Willson, M.D., 1100 N. Charles St., Baltimore 1. Meets third Tuesday, September to May.

MARYLAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Nathan B. Hyman, M.D., 1805 Eutaw Place, Baltimore 17.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary-Treasurer*, Joseph O. Reed, Jr., M.D., 3825 Brush, Detroit 1. Meets first Thursday, October to May, Wayne County Medical Society rooms.

UPPER PENINSULA RADIOLOGICAL SOCIETY. *Secretary*, Arthur Gonty, M.D., Menominee. Meets quarterly.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Donald H. Peterson, M.D., 25 W. Fourth St., St. Paul 2. Meets Fall, Winter, and Spring.

Mississippi

MISSISSIPPI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert P. Henderson, M.D., 316 Medical Arts Bldg., Jackson. Meets monthly, on third Thursday, 6:00 P.M., at Hotel Edwards, Jackson.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary-Treasurer*, Samuel B. Chapman, Jr., M.D., 830 Argyle Bldg., Kansas City, Mo. Meets last Friday of each month.

GREATER ST. LOUIS RADIOLOGICAL SOCIETY, *Secretary-Treasurer*, Charles J. Cherre, M.D., 462 N. Taylor, St. Louis 8. Meets on fourth Wednesday, October to May.

Montana

MONTANA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arthur T. Austin, M.D., 104 Doctors Bldg., Billings. Meets annually.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Wayne K. Tice, M.D., 128 N. 13th St., Lincoln 8. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

New England

CONNECTICUT VALLEY RADIOLOGIC SOCIETY. *Secretary-Treasurer*, Paul J. Kingston, M.D., 114 Woodland St., Hartford, Conn. Meets second Friday of October and April.

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, John E. Gary, M.D., 1180 Beacon St., Brookline 46, Mass. Meets third Friday, October through May, Longwood Towers, Brookline, Mass.

New Hampshire

NEW HAMPSHIRE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Paul Y. Hasserjian, M.D., 1470 Elm St., Manchester. Meets three times a year.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Andrew P. Dedick, Jr., M.D., 67 E. Front St., Red Bank. Annual meeting in May, Atlantic City; Fall meeting October or November, Newark.

New York

BROOKLYN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, George A. Manfredonia, 1 Hanson Place. Meets first Thursday, October through May.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary*, Alfred H. Dobrak, M.D., 108 Pine St., Buffalo. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Joseph A. Head, M.D., University Hospital, 150 Marshall St., Syracuse. Meets second Monday, October through May.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, C. P. Naidorf, M.D., 411 Parkside Ave., Brooklyn 26. Meets fourth Thursday, October to April (except December), at 9:00 P.M., Kings County Medical Bldg.

NASSAU RADIOLOGICAL SOCIETY. *Secretary*, Jerome Zwanger, M.D., 126 Hicksville Road, Massapequa. Meets second Tuesday, February, April, June, October, and December.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Harold G. Jacobson, M.D., Montefiore Hospital, 210th St. and Bainbridge Ave., New York 67, N. Y.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Irving Van Woert, Jr., M.D., Albany Hospital, Albany. Meets in the capital area second Wednesday, October, November, March, and April; annual meeting, May or June.

RADIOLOGICAL SOCIETY OF STATE OF NEW YORK. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meets annually with the State Medical Society.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, John W. Colgan, M.D., 277 Alexander St., Rochester 18. Meets at Strong Memorial Hospital, 8:15 P.M., last Monday of each month, September through May.

WESTCHESTER RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arnold Myron Wald, M.D., 406 Boston Post Road, Port Chester. Meets third Tuesday of January and October and as announced.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, William H. Sprunt, M.D., North Carolina Memorial Hospital, Chapel Hill, N. C. Meets in April and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, Marianne Wallis, M.D., Minot. Meets in the Spring with State Medical Association; in Fall or Winter on call.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary*, Francis C. Curtzwiler, M.D., 421 Michigan St., Toledo. Next annual meeting, Cincinnati, May 1959.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arthur R. Cohen, M.D., 41 S. Grant Ave., Columbus. Meets second Thursday, October, November, January, March, and May, 6:30 P.M., Fort Hayes Hotel, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Frederick A. Rose, M.D., 2065 Adelbert Road, Cleveland 6. Meets at 7:00 P.M., fourth Monday, October, November, January, February, March and April, at Tudor Arms Hotel.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Warner A. Peck, Jr., M.D., 441 Vine St., Cincinnati 2. Meets first Monday, September through May, at Cincinnati General Hospital.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, G. F. Johnson, M.D., 1030 Reibold Bldg., Dayton 2, Ohio. Meets monthly, second Thursday, Miami Valley Hospital, Dayton.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary*, Edmond H. Kalmon, Jr., M.D., 300 Northwest 12th St., Oklahoma City.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, C. V. Allen, M.D., 9855 S.W. Hawthorne Lane, Portland. Meets monthly, second Wednesday, October to June, at 8:00 P.M., University Club, Portland.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Arch Colbrunn, M.D., 1919 Royal Oak Drive, Roseburg, Ore. Meets in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Walter P. Bitner, M.D., 234 State St., Harrisburg. Next annual meeting, April 24–25, 1959, Harrisburg.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, Roderick L. Tondreau, M.D., 3400 Spruce St., Philadelphia 4. Meets first Thursday of each month at 5:00 P.M., from October to May, in Thompson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY. *Secretary*, Erwin Beck, M.D., 3500 Fifth Ave., Pittsburgh 13.

Meets monthly, second Wednesday, October through June, Park Schenley Restaurant.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John H. Freed, M.D., 4200 E. Ninth Ave., Denver 20, Colo.

South Carolina

SOUTH CAROLINA RADIOLOGICAL SOCIETY. *Secretary*, Wayne Reeser, M.D., 1600 Ninth Ave., Conway. Meets with State Medical Association in May.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Donald J. Peik, M.D., 303 S. Minnesota Ave., Sioux Falls. Meets during annual meeting of State Medical Society.

The Southeast

Southern Radiological Conference. *Secretary-Treasurer*, Marshall Eskridge, M.D., 1252 Springhill Ave., Mobile, Ala.

The Southwest

SOUTHWESTERN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Gordon L. Black, M.D., 1501 Arizona Bldg., El Paso, Texas.

Tennessee

MEMPHIS ROENTGEN SOCIETY. *Secretary-Treasurer*, James L. Booth, M.D., 899 Madison Ave., Memphis 3. Meets monthly first Monday, John Gaston Hospital.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James J. Range, M.D., P. O. Box 324, Johnson City. Meets annually with State Medical Association in April.

Texas

DALLAS-FORT WORTH RADIOLOGICAL CLUB. *Secretary*, Albert H. Keene, M.D., 3707 Gaston Ave., Dallas. Meets monthly, third Monday, 6:30 P.M., at the Greater Fort Worth International Airport.

HOUSTON RADIOLOGICAL SOCIETY. *Secretary*, Edward Singleton, M.D., 6621 Fannin St., Houston 25. Meets last Monday of each month at the Doctors' Club.

SAN ANTONIO-MILITARY RADIOLOGICAL SOCIETY. *Secretary*, Hugo F. Elmendorf, Jr., M.D., 730 Medical Arts Bldg., San Antonio 5, Texas. Meets at Fort Sam Houston Officers' Club, third Wednesday of each month, 6:30 P.M.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, JARRELL E. MILLER, M.D., 3500 Gaston Ave., Dallas. Next meeting in Dallas, Jan. 30–31, 1959.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City 1. Meets third Wednesday, January, March, May, September, November.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, Frank A. Kearney, 2nd, M.D., 110 S. Curry St., Phoebus.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Wayne A. Chesledon, M.D., 306 Stimson Bldg., Seattle 1. Meets fourth Monday, September through April, at College Club, Seattle.

West Virginia

WEST VIRGINIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Karl J. Myers, M.D., 12 N. Woods St., Philippi. Meets with State Medical Society, and as arranged by Program Committee.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Joseph F. Wepfer, M.D., 5000 W. Chambers St., Milwaukee 10. Meets fourth Monday, October through May, at the University Club.

SECTION ON RADIOLOGY, STATE MEDICAL SOCIETY OF WISCONSIN. *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee 2. Meets in October with State Medical Society.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursday at 4 P.M., September to May, Service Memorial Institute.

WISCONSIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Farrell F. Golden, M.D., 5221 Tonyawatha Trail, Madison 4.

Puerto Rico

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA. *Secretary-Treasurer*, Dr. R. B. Díaz Bonnet, Suite 504, Professional Bldg., Santurce, P.R.

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, Guillaume Gill, M.D.; *Associate Honorary Secretary-Treasurer*, Robert G. Fraser, M.D. *Central Office*, 1555 Summerhill Ave., Montreal 25, Quebec. Meets in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTRO-RADIOLOGIE MÉDICALES. *General Secretary*, Louis Ivan Vallée, M.D., Hôpital Saint-Luc, 1058 rue St-Denis, Montreal 18. Meets third Saturday of each month.

L'ASSOCIATION DES RADIOLOGISTS DE LA PROVINCE DE QUEBEC. ASSOCIATION OF RADIOLOGISTS OF THE PROVINCE OF QUEBEC. *Secretary*, Isadore Sedlezky, M.D., 3755 Cote St. Catherine Road, Montreal. Meets four times a year.

TORONTO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, L. R. Harnick, M.D., X-Ray Department, Toronto Western Hospital, 399 Bathurst St. Meets second Monday evening, September to May.

CUBA

SOCIEDAD CUBANA DE RADIOLOGÍA Y FISIOTERAPIA. *Secretary*, Dr. Miguel A. García Plasencia, Hospital Curie, 29 y F, Vedado, Havana. Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA. *Headquarters*, Calle de Coahuila, Núm. 35, Mexico 7, D. F. *Secretary General*, Dr. Jorge Ceballos Labat. Meets first Monday of each month.

PANAMA

SOCIEDAD RADIOLÓGICA PANAMEÑA. *Secretary-Editor*, Luis Arrieta Sánchez, M.D., Apartado No. 86, Panama, R. de P.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck; The Spinal Cord

The Chest

The Heart and Blood Vessels

RADIOTHERAPY

RADIOISOTOPES

RADIATION EFFECTS—PROTECTION

THE HEAD AND NECK; THE SPINAL CORD

Radiologic Examination of the Brain and Spinal Cord. Erik Lindgren. Acta radiol. supp. 151, 1957, pp. 1–147. (Roentgen Department, Serafimerlasarettet, Stockholm, Sweden)

This supplement to *Acta radiologica* is made up of the lectures delivered by Dr. Lindgren in the University of Minnesota Continuation Courses in Neuroradiology in November 1955, and does not lend itself to abstracting in the usual manner. A review of the contents will, however, indicate its scope.

The publication makes no pretense at being a complete dissertation on the enormous field of neuroradiology. Rather, a concentrated discussion of several aspects is so presented that the reader is stimulated to seek further information on the various subjects and to give original thought to the problems he may encounter in his daily practice.

The greater part of the booklet is concerned with the brain and there are brief discussions of technic of pneumoencephalography and cerebral angiography as practiced in the author's department. Normal ventricular, cisternal, and vascular anatomy is presented, with emphasis on less well understood points and on normal variations. Separate sections are devoted to pneumoencephalographic examination in lesions of the posterior fossa and basal cisterns, and supratentorial tumors. An excellent discussion of diagnosis of tumor type by vascular pattern follows, and an intriguing section on tentorial herniations is presented. The bony changes in pituitary and eighth nerve tumors are discussed. The final section considers the advantages and technics of the use of gas and water-soluble contrast media as myelographic agents.

One hundred seventy-eight excellent reproductions and illustrations accompany the text and illustrate all points. There are numerous photographs of anatomical specimens which are correlated with the radiographic appearance.

In general, it is remarkable that so much detailed information has been concentrated into so few pages. This publication will be of the greatest benefit to the post-residency radiologist, neurosurgeon, or neurologist who wishes to improve his neuroradiologic diagnosis, utilizing the sound technics followed by Dr. Lindgren and his Swedish school. The less advanced reader will find much of interest to expand and clarify information found in standard texts. This fine publication should be in the library of all who are seriously interested in neuroradiology.

J. E. Shick, M.D.
The Henry Ford Hospital

Gliomas of the Optic Pathways in Childhood. Fred D. Fowler and Donald D. Matson. J. Neurosurg. **14:** 515–528, September 1957. (Children's Medical Center, Boston, Mass.)

Thirteen patients were seen at the Children's Medical Center (Boston) in the past ten years with a verified diagnosis of glioma of the optic pathway. On the basis of symptomatology and physical findings, the cases fell into two groups, depending on whether the tumor was predominantly intraorbital (4 cases) or intracranial (9 cases). A case in each group is reported to illustrate some of the important differences. Progressive unilateral proptosis along with decreasing visual acuity is the common presenting clinical picture in the primarily intraorbital gliomas. Increased intracranial pressure combined with decreasing visual acuity is the characteristic feature of primarily intracranial optic pathway gliomas.

The authors emphasize that gliomas of the optic pathways may be present either intracranially or intraorbitally without any alteration in the appearance of the plain roentgenogram and also that the radiographic signs produced by these tumors are not pathognomonic. Plain orbital roentgenograms in patients with intraorbital gliomas may show evidence of enlargement of optic foramina. It is always necessary to compare both sides in order to discover minor variations. It must be remembered, however, that the foramina are absolutely symmetrical in only 45 per cent of the normal population; in 40 per cent they may differ as much as 10 per cent in size, and in the remainder variations up to 20 per cent may be noted. The contour is normally smooth; therefore, any irregularity, hyperostosis, or erosion is apt to be pathological. The commonest abnormal finding in patients with gliomas of the optic nerve is a smooth circular expansion of the optic foramen.

In 2 of the authors' 4 cases of intraorbital tumors there was enlargement of the optic foramen. The tumor in these cases did not extend all the way through the optic canal. If this roentgen sign had been used as a contraindication to surgery, as suggested by Taveras *et.al.* (Radiology **66:** 518, 1956), the opportunity of curing these children would have been lost. Another of the intraorbital tumors caused slight enlargement of the entire orbit, the foramen being normal. In 1 patient the plain roentgenograms were entirely normal. Angiography was performed in 2 patients with intraorbital tumors, and the findings were normal.

The plain roentgenograms of the skull of all patients in the intracranial group proved to be abnormal. In 4, the optic foramen was enlarged and in 2 the sella turcica was eroded. The characteristic deformity of the sella turcica associated with glioma of the optic pathway is a pear-shaped configuration of the bony contour produced by erosion of the tuberculum sellae and the anterior clinoid process. In the 3 remaining patients in this group changes in both the sella and optic foramen were demonstrable.

On the basis of their experience and that of others, the authors believe that transfrontal craniotomy and orbital unroofing offers the best opportunity for satisfactory evaluation of the extent of these lesions and the only opportunity for complete removal when this is surgically feasible. In 5 of the 13 cases, including the 4 in the intraorbital group, total excision was felt to have been accomplished. The 4 patients with purely intraorbital tumors were living and well one month, eight months, five years, and eight years following operation; all have normal vision in the remaining eye. Of the 9 patients in the intracranial group, 2 died postoperatively The other 7 patients are living, 6 of them with useful vision. One patient in the intracranial group was given 4,850 r to the region of the chiasm and involved orbit and another was given 2,830 r to the intracranial portion of the optic nerves and chiasm. There was no evidence of improvement in either of these 2 patients; however, their signs have not progressed significantly six months and four years after treatment. In the 5

patients who had no treatment other than partial surgical excision, the results are comparable. It is concluded that if a glioma of the optic pathways cannot be completely excised, it would be well to give roentgen therapy to the areas involved in the hope that it might be of some value in delaying further growth. It cannot be assured, however, that any improvement in neurologic status will follow such treatment.

Three roentgenograms; 5 photographs; 1 photomicrograph.

Glioblastoma Multiforme of Both the Septum Pellucidum and the Corpus Callosum. Case Report. Joseph A. Epstein and Bernard S. Epstein. J. Neurosurg. **14:** 688–692, November 1957. (B. S. E., Department of Radiology, Long Island Jewish Hospital, New Hyde Park, N. Y.)

A specific diagnosis of tumor of the septum pellucidum, corpus callosum, or both, usually cannot be made on clinical grounds alone. All share a common constellation of symptoms caused primarily by increased intracranial pressure. Involvement of the adjacent frontal lobes, cingulate gyri, and fornix, may, however, contribute to the symptom complex. Headache and vomiting appear early, followed by apathy, confusion, disorientation, loss of memory, and a fluctuating state of consciousness, with few localizing or lateralizing signs of value. A striking loss of spontaneous expression may be present. Apraxia is of distinct value but may be difficult to elicit. The diagnosis can be established by pneumoencephalography. Separation of the lateral ventricles by a thickened septum pellucidum, distortion of the roofs of the lateral ventricles, and deformity of the third ventricle are distinctive features. The majority of such neoplasms are malignant gliomas, which are inaccessible surgically.

A case is reported in which there was simultaneous tumefaction of the septum pellucidum and the corpus callosum. Ventriculography disclosed the unusual combination of an almost symmetrically widened septum pellucidum and a definite indentation into the roofs of the lateral ventricles. This pneumoencephalographic pattern has not been described either in previously recorded cases of tumors or cysts of the septum pellucidum or of tumors of the corpus callosum. The necropsy findings clearly accounted for the unusual roentgen picture by showing extension of the tumor from the thickened septum pellucidum into the tumefied corpus callosum. Whether the tumor originated in one location or the other could not be ascertained, since the involvement of both was equal.

Two roentgenograms; 2 photographs.

Roentgenologic Differential Diagnosis of Pituitary Adenoma with Special Consideration of the Primary and Secondary Sellar Changes. W. Tönnis, G. Friedmann, and H. Albrecht. Fortschr. a. d. Geb. d. Röntgenstrahlen **87:** 677–686, December 1957. (In German) (Neurochirurgische Universitätsklinik, Köln-Lindenburg, Germany)

An attempt is made to identify roentgenologically the various types of pituitary adenoma and to differentiate between *primary* sellar enlargement, due to pituitary adenoma, and *secondary* enlargement as a result of increased intracranial pressure. For this investigation 62 chromophobe adenomas, 62 of mixed type, 8 eosinophil, and 2 basophil adenomas were reviewed.

While a clinical diagnosis of the type of pituitary adenoma is sometimes possible, roentgenologically the sellar changes fail to offer a specific clue. On the other hand, sellar alterations secondary to increased intracranial pressure show certain characteristic findings: (1) sellar enlargement is usually limited and occurs in but 25 per cent of the cases; (2) pressure atrophy of the dorsum sellae predominates; (3) the sellar floor shows an even depression without presence of a double contour; (4) the anterior clinoid processes remain unremarkable.

The diagnosis of sellar enlargement is usually confirmed by other signs of increased intracranial pressure: separation of sutures, prominence of convolutional markings, pineal displacement, localized bone destruction, hyperostosis, or tumor calcification.

Sixteen roentgenograms; 1 drawing; 2 graphs; 3 tables.

ERNEST KRAFT, M.D.
Northport, N. Y.

Vertebral Arteriography in the Study of Subarachnoid Hemorrhage. Edward L. Spatz and J. W. D. Bull. J. Neurosurg. **14:** 543–547, September 1957. (St. George's Hospital, London, England)

Vertebral arteriography was carried out in 60 patients in whom bilateral carotid arteriography failed to reveal a source of bleeding. No case was included in which a posterior lesion was suspected and diagnosed by vertebral arteriography as a primary procedure. The diagnosis in each instance was confirmed by lumbar puncture. In no case was there an apparent hemorrhagic diathesis. None of the patients had suffered craniocerebral injury. With the exception of a single case, the main symptom was severe headache, usually of abrupt onset. Physical signs were of two types: those caused by contamination of the subarachnoid space with blood and those attributable to a focal neurologic deficit.

Vertebral arteriography was entirely percutaneous *via* an anterior approach, with general endotracheal anesthesia. In 16 cases (26 per cent) lesions capable of producing the subarachnoid hemorrhage, and assumed to be responsible for it, were demonstrated. Eight of these were aneurysms and 8 were angiomas. The posterior cerebral arteries were shown by carotid injection in 21 of the 60 cases (35 per cent). Analysis of the 16 pathological cases revealed no filling of the posterior cerebral arteries in 13; both posterior cerebral arteries were visualized in 1 case, and one posterior cerebral artery was filled in 2 cases. In none of the last 3 was the "feeding" or source vessel demonstrated. The plain roentgenograms of the skull were normal in all but 1 case, in which erosion of the dorsum sellae was seen—a sign of no localizing value.

Three of the 16 patients were cured by total excision of the lesion: occipital angioma, vermis angioma, and vertebral aneurysms.

The authors conclude that vertebral arteriography should be undertaken when bilateral carotid arteriography fails to show a source of subarachnoid hemorrhage. It may reveal a surgically accessible lesion. If total study is negative, the physican can more securely offer the patient a good prognosis. Both posterior cerebral arteries must be filled to exclude supratentorial angiomas and aneurysms.

Three roentgenograms; 1 table.

Combined Retino-Cerebellar Angiomatosis and Deep Cervical Angiomas. Case Report. Giovanni Di Chiro. J. Neurosurg. **14:** 685–687, November 1957. (Neurological Institute, University of Naples, Naples, Italy)

A case of retinocerebellar angiomatosis associated with deep cervical angiomas is presented. This is believed to be the first such case to be recorded. When he was sixteen, the patient noticed gradual and progressive dimness of vision, first of one eye and then the other. In approximately three years he became blind. Subjective sensory disturbances, followed by severe pain of radicular type, appeared at the age of twenty-four, and symptoms and signs of increased intracranial pressure developed.

Plain roentgenograms showed no clear-cut signs of increased intracranial pressure. In each orbit a linear, circular calcification was present, exactly the size of the posterior and middle portions of the eyeballs. Left vertebral angiograms revealed at least two posterior fossa and two deep cervical angiomatous formations. The two intracranial formations had the appearance of homogeneous rounded sacs, the size of a bean, and were fed by branches of the posterior inferior cerebellar artery; no definite displacement of small vessels surrounding these sacs, pointing to a possible associated cystic tumor, was demonstrable. The two deep cervical formations were located at the level of and behind the posterior border of the body of the third cervical vertebra. The upper one was irregular in contour and was not homogeneously dense. The lower formation more closely resembled those within the cranium. Both structures were fed by branches of the vertebral artery and were drained by a peculiar bead-shaped vessel, directed upward, toward the base of the skull. In order to rule out the possibility of similar supratentorial lesions, right carotid arteriography was performed; this showed only indirect signs of a slight internal hydrocephalus and an ophthalmic artery notably larger than usual.

In the author's opinion, the brachialgic syndrome could be explained by the presence of the deep cervical angiomas, connected with the vertebral artery system. No surgical procedure was carried out.

Three roentgenograms.

Successful Separation of Craniopagus Twins. Harold C. Voris, Wayne B. Slaughter, Joseph R. Christian, and Edward R. Cayla. J. Neurosurg. **14:** 548–560, September 1957. (30 N. Michigan Blvd., Chicago 2, Ill.)

The successful surgical separation of craniopagus twins depends on the presence of separate brains with independent vascular circulations. Thorough preoperative study with adequate visualization of ventricles and subarachnoid spaces (pneumoencephalography or ventriculography) and the arterial and venous circulations (angiography) and the co-operation of neurologic and plastic surgeons, pediatricians, and anesthesiologists are essential.

The authors describe their preoperative studies in craniopagus twin girls and the surgical procedures involved in their separation at about seven months of age. Both children survived and were well at the age of two. One had some neurological deficit; the other appeared to be developing normally.

Eleven roentgenograms; 3 photographs; 4 diagrams; 2 tables.

Thinning of the Parietal Bones. Ashley Jackson. Proc. Coll. Radiologists Australasia **1:** 74–76, December 1957. (School of Radiology, R. P. A. Hospital, Sydney, N. S. W., Australia)

The author presents two cases of symmetrical thinning of the parietal bones and discusses the etiology, pathology, and differential diagnosis. Routine postero-anterior and lateral skull films are adequate for diagnosis. Involvement is usually, but not invariably, bilateral and symmetrical. There are two types of thinning: (1) flattened or depressed triangular or quadrilateral areas in the parietal bones; (2) longitudinal grooving along either side of the sagittal suture, occasionally extending into the frontal or occipital bone. The site of involvement is between the sagittal suture and the parietal prominence, the center of the area of thinness usually lying midway between the anterior and posterior borders of the parietal bones. The defects do not extend across the midline and characteristically there is a crest-like ridge of intervening bone. The lateral view shows parietal thinning as an area of decreased density in the parasagittal region, with a smooth, regular, well defined border parallel to the skull base.

Four roentgenograms; 1 diagram.

GORDON L. BARTEK, M.D.
Grand Rapids, Mich.

Spontaneous Pneumocephalus Secondary to Sarcoma of the Ethmoid. Michael Holmes, Luther Martin, and Richard Hanckel. Ann. Otol., Rhin. & Laryng. **66:** 1021–1028, December 1957. (96A Bull St., Charleston, S. C.)

Traumatic pneumocephalus usually occurs as a result of fracture of the intracranial surface of the sphenoid, ethmoid, or frontal sinus, or of the mastoid cells. Nontraumatic or spontaneous pneumocephalus usually is caused by erosion of the intracranial surface of the paranasal sinuses or mastoid cells by a tumor or an infectious process.

Of the 30 reported cases of pneumocephalus collected by Raider in 1951 (Am. J. Roentgenol. **66:** 231, 1951), 21 were the result of a neoplasm. The authors' case is believed to be the first in the literature secondary to a neoplasm in the ethmoid area and the first associated with a sarcoma. The tumor was first seen as a polypoid mass in the right nasal cavity and was removed by snaring. Two weeks later it had recurred and was removed a second time. An exophthalmos developed, along with headaches, chills, and temperature elevation, and the patient became irrational. Roentgenograms demonstrated air in both lateral ventricles and probable osseous destruction of the medial margin of the right orbit. A right frontal osteoplastic craniotomy revealed a large infiltrating tumor extending from the right ethmoid region through the cribriform plate into the frontal lobe. No attempt at excision was made.

The microscopic specimen was considered to represent a malignant lymphoma of the reticulum-cell sarcoma class.

DEAN W. GEHEBER, M.D.
Baton Rouge, La.

Impressions on the Vertebral Artery by Deformations of the Unco-vertebral Joints. Post-mortem Angiographic Studies. Pekka Virtama and Erkki Kivalo. Acta radiol. **48:** 410–412, December 1957. (Kivelä Hospital, Helsinki, Finland)

The purpose of the study reported here was to ex-

amine the changes in the vertebral artery caused by neighboring parts of the cervical vertebrae. Postmortem roentgen examinations of the vertebral arteries after injection of a barium-formalin suspension were done in 19 patients, ranging in age from fifty-two to ninety-two years. In 10 of 12 cases with osteochondritis in the apophyseal joints and the uncovertebral junctions, there were marked alterations in the vertebral artery, consisting of displacement and/or compression. These changes were due to osteophytes around the uncovertebral joints and were more prominent in the two lowest cervical vertebrae. Two of the cases in which there was osteochondritis showed no abnormality of the vertebral arteries.

[The uncovertebral joints, known also as Luschka joints, are small synovial articulations between the five lower cervical vertebral bodies. See Boreadis and Gershon-Cohen: Radiology **66**: 181, 1956.]

Two roentgenograms. HOWARD GOULD, M.D.
St. Vincent's Hospital, N. Y.

Clinical Contribution to Symptomatology of Phacomatosis. G. W. Schimmelpenning. Fortschr. a. d. Geb. d. Röntgenstrahlen **87**: 716–720, December 1957. (In German) (Universitäts-Nervenklinik, Münster i. Westf., Germany)

Phacomatosis is a congenital dysontogenetic process involving primarily the ectodermal layers (skin, brain, eye), but to some extent also the mesodermal and entodermal tissues. Included in this syndrome are neurofibromatosis, tuberous sclerosis, v. Hippel-Lindau disease, and Sturge-Weber disease.

The author describes the case of a girl of seventeen, with cerebral spastic convulsions, a systemic nevus sebaceus of the left portion of the scalp, and a vascular nevus on the left side of the neck, together with a tumor and a coloboma of the left upper eyelid. Of special roentgenologic interest was an extensive monostotic fibrous dysplasia of the left hemicranium, resembling that described by Jaffe and Lichtenstein except that it was unilateral and interspersed cystic areas were absent.

Two roentgenograms; one photograph.
ERNEST KRAFT, M.D.
Northport, N. Y.

Circulatory Dynamics of the Canine Spinal Cord. Temporal Phases of Blood Flow Measured by Fluorescein and Serioroentgenographic Methods. G. Margolis, A. T. Griffin, P. D. Kenan, G. Tindall, E. H. Laughlin, and R. L. Phillips. J. Neurosurg. **14**: 506–514, September 1957. (Duke University School of Medicine, Durham, N. C.)

An attempt has been made to obtain fundamental information about spinal cord circulation by means of fluoroscein and serioroentgenograms. The temporal phases of blood flow through the canine spinal cord and cerebral cortex were measured by a fluorescein indicator method, a modification of the technic used by Minard to study the cerebral circulation time (Naval Medical Research Institute, Bethesda, Md., Project N. M. 007 081.07.04, 1950, 1–14). The circulation time of the spinal cord varied from 1.9 to 3.4 seconds and that of the brain 0.9 to 2.0 seconds. The duration of exposure (regional application time) to a standard dose of indicator dye was 6.2 to 11.2 seconds for the cord and 6.0 to 12.7 seconds for the cerebral cortex. The influence of posture upon the measured variables of the circulation was tested and found to be negative. The significance of these observations for the interpretation of the mechanisms of contrast medium injury to the nervous system are discussed. It is concluded that the cord has no intrinsic circulatory features which render it particularly susceptible to contrast medium injury.

The significant value derived from the serial roentgenographic studies was the indirect figure of 4 seconds for the circulation time of the spinal cord. The contrast agent appeared in the anterior spinal artery immediately after the end of the injection. This trunk remained visible for 3.5 seconds, but the medium could not be demonstrated in the posterior arterial trunk or more peripherally in the anterior arterial tree or in the intrinsic or pial venous circulation of the spinal cord. The anterior internal vertebral venous plexus began to fill 4 seconds after the anterior spinal artery and showed a gradually deepening opacity over the next 3 seconds. Recirculation of the radiopaque media, particularly Thorotrast, obscured the terminal features of these agents. Since the medullispinal veins could not be demonstrated, this technic is not adequate as a direct method of measuring the rate of blood flow in the spinal cord.

Four roentgenograms; 2 tables.

THE CHEST

Combined Tomography and Bronchography (Tomobronchography) in the Investigation of Pulmonary Disease. Bryan Gandevia. M. J. Australia **2**: 813–816, Dec. 7, 1957. (Hammersmith Chest Clinic, London, W. 12, England)

The author utilized simultaneous tomography and bronchography in 30 cases to evaluate the results of this combined technic. The medium used was Oily Dionosil. All films were taken with the patient in the horizontal position and no fluoroscopic control was employed. It is concluded that in certain cases, tomobronchography is a valuable adjunct to conventional bronchography, because of its ability to reveal simultaneously a parenchymal lesion and its related bronchus, and to clarify anatomical relationships, particularly where the normal anatomy is seriously disturbed. It also gives confidence to the interpretation of minute abnormalities of small bronchial subdivisions.

Six roentgenograms. THEODORE E. KEATS, M.D.
University of Missouri

A Simple Technique for Bronchography. Robert H. Holland. J.A.M.A. **165**: 1819–1820, Dec. 7, 1957. (4500 S. Lancaster Rd., Dallas 2, Texas)

The author describes a simplified bronchographic technic which he states has been achieved by trial and error from methods developed by others. The key maneuver consists in insertion of the intratracheal catheter through the nasal cavity while the patient sits upright on the table after appropriate topical anesthesia. The catheter is inserted through the nose while the tongue is pulled forward and the patient inspires gently. The tip of the tube will almost invariably find its proper position as it is advanced through the pharynx into the trachea. After the catheter is in position in the upper trachea, 3 c.c. of 5 per cent Cyclaine is injected through the tube once or twice to aid in anesthetizing the bronchial tree. Filling of the individual lobes of the examined lung is accomplished under fluoroscopic control,

with gradual injection of Oily Dionosil. Changing of the patient's position will facilitate filling of the desired segments.

This method yielded satisfactory bronchograms in 92 of the last 100 studies done by the author. Failures were usually attributable to unsatisfactory premedication or an attempt to combine bronchoscopy and bronchography. Patients with profuse secretions rarely obtain a good surface anesthesia so that the examination is difficult and results tend to be less satisfactory.

Two roentgenograms; 1 photograph; 1 diagram.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

The Use of Angiocardiography as an Aid in the Diagnosis of Pulmonary Disease. Harold A. Lyons. J.A.M.A. **165:** 1939–1943, Dec. 14, 1957. (451 Clarkson Ave., Brooklyn 3, N. Y.)

Over 600 patients with pulmonary disease have been studied by angiocardiography with 70 per cent sodium acetrizoate (Urokon sodium) without a single fatality. This procedure allows visualization of the lobar and segmental branches of the pulmonary arteries and their subdivisions and will thus frequently bring to light important diagnostic information not obtainable by any other method. Such contrast studies should be utilized in patients with mediastinal masses to allow exclusion of vascular lesions and provide information as to the relation of the mass to important vascular structures. Opacification of major pulmonary vessels will frequently indicate whether a bronchogenic carcinoma is inoperable, as evidenced by invasion of the superior vena cava or other major branches. The procedure may also supply valuable information relative to the efficacy of therapeutic drugs in cases of tuberculosis or other chronic lung infections. Demonstration by this procedure of the vascularity—or avascularity—of a given lesion will provide critical information.

Seven short clinical summaries and appropriate roentgenograms are presented demonstrating the value of angiocardiography in specific diagnostic problems as noted above.

The author concludes that study of pulmonary vasculature by angiocardiography is frequently a very helpful procedure of low morbidity and mortality with rewarding diagnostic information. The performance of this procedure is not nearly so dangerous in patients with chronic lung disease as in patients with abnormal circulation times and/or congenital heart disease.

Eight roentgenograms.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Foreign Body in the Right Main Bronchus for 1 1/2 Years. Thomas de Roos. Canad. M. A. J. **77:** 960–963, Nov. 15, 1957. (602 Seventh Ave., New Westminster, B. C., Canada)

An aspirated foreign body rarely penetrates the trachea in such a manner as to remain immobile for a long period. In most cases the acute symptoms and discomfort lead to removal as soon as possible.

The case is reported of a healthy 25-year-old man who had a persistent cough for almost three months. This gradually became worse and a clinical picture of tracheal obstruction developed. Roentgenograms of the chest were at first interpreted as normal. On review of the original films with some taken ten days later, however, there seemed to be a subtle difference in appearance of each lung and a suggestion of alteration in aeration of one or other lung. Bronchograms were then made, which showed a very marked deformity at the level of the carina. There was a filling defect about 1.5 cm. in length on the superior surface of the junction of the right main bronchus and the trachea. This defect extended irregularly around the trachea, involving the left main bronchus as well as its origin from the trachea. There seemed to be an intrinsic mass spreading irregularly, most likely of a neoplastic nature.

On bronchoscopy, a grayish mass was seen protruding from the right anterolateral wall of the trachea, occluding it for about 25 per cent of its lumen. Biopsy of the tissue showed only a very dense diffuse chronic inflammatory cell infiltrate. A history was then obtained from the patient of the loss of part of a dental plate during a fight while intoxicated. In none of the chest roentgenograms could a foreign body be identified. Bronchoscopy under general anesthesia was carried out and a narrowed obstruction was found in the right bronchus, a short distance below its origin from the trachea. Foreign body forceps were introduced and a large piece of dental plate was removed. The patient was completely relieved of his symptoms.

Two roentgenograms; 2 photographs.

Thoracic Meningocele Associated with Neurofibromatosis. Eric M. Nanson. J. Thoracic Surg. **33:** 650–662, May 1957. (University of Saskatchewan, Saskatchewan, Canada)

A case of thoracic meningocele associated with neurofibromatosis and acute kyphoscoliosis is reported. These conditions may be considered to constitute a syndrome which is not generally recorded in connection with von Recklinghausen's disease. The patient was a 34-year-old woman with marked kyphosis and manifestations of von Recklinghausen's disease dating back to early life. Three years before admission she had fallen on her buttocks and sustained cord damage. She stated that the kyphoscoliosis had not been present before that time, but the author finds it hard to accept this as fact.

Five years before the patient was admitted to the hospital, a chest film taken in the course of a tuberculosis survey showed a mass in the right hemithorax. At the time of her fall, this had been shown to occupy about two-thirds of the right lung field. Some progression in the size of the mass occurred over the succeeding three years, with progressive shortness of breath. Roentgenograms now showed a tremendous mass occupying a greater portion of the right hemithorax; in the lateral view this seemed to lie primarily in the middle of the posterior mediastinum. There was a gross kyphoscoliosis of such a degree that, in the anteroposterior projection, a direct view was obtained along the lumen of the upper thoracic vertebral canal. The apex of the kyphosis appeared to be at the level of the fourth thoracic vertebra. The preoperative diagnosis was a large neurofibroma occupying the right chest.

As in previously reported cases, the diagnosis was not suspected until operation. The author believes, however, that a correct preoperative diagnosis should be possible by means of myelography, with suitable positioning to cause the opaque medium to enter the sac.

Surgical excision of the tumor, with careful closure of the neck of the sac, is the treatment of choice.

Three roentgenograms; 2 photographs; 2 photomicrographs; 2 tables.

Giant Lobar Malformative Emphysema of the Young Child; Four Cases Cured by Exeresis, with Anatomico-clinical Observations. P. Santy, M. Jeune, P. Galy, M. Jaubert de Beaujeu, M. Bethenod, and E. Bailly. J. franç. de méd. et chir. thorac. **11**: 457–478, 1957. (In French) (Lyons, France)

Four case reports are given to illustrate the condition called by the authors giant lobar malformative emphysema. Usually the child has symptoms quite early, in the first few months of life. The onset is often sudden, with the appearance of asphyxiation, cyanosis, and physical signs of localized emphysema. Radiologic studies show increased radiolucency of the involved region, more marked on expiration, sometimes presenting the appearance of a large pseudocavity. Bronchographic studies reveal only slight bronchial narrowing in the involved region and displacement of the adjacent bronchi. Angiopneumographic studies have shown decrease in size of the vessels entering the region.

Bronchoscopy is indicated to rule out the presence of foreign bodies, lymph-node compression, or inflammatory stenotic processes. If these processes are excluded, the possibility that there is actually a malformation with the formation of large emphysematous areas should be considered. Since this process is irreversible, surgery is recommended.

Eight roentgenograms; 1 photomicrograph; 3 photographs. CHARLES M. NICE, JR., M.D.
Tulane University, New Orleans, La.

Lobar Emphysema in a Baby. John Saxton. Proc. Coll. Radiologists Australasia **1**: 71–74, December 1957. (School of Radiology, R. P. A. Hospital, Sydney, N. S. W., Australia)

Lobar emphysema in afebrile, otherwise healthy babies is a distinct entity. The diagnosis depends almost wholly on the radiologic findings and can be made without difficulty if the radiologist is alert. The condition is an obstructive emphysema affecting either of the upper lobes or the middle lobe. The etiology is undetermined; a check-valve mechanism appears to be operative in some cases. Clinically the disease is manifest by increasingly severe attacks of dyspnea with or without cyanosis in a previously healthy infant.

The roentgen findings are as follows: radiolucency of the greater part of one hemithorax; displacement of the heart and mediastinum to the opposite side; depression of the diaphragm, widening of the intercostal spaces, separation and partial obliteration of the bronchovascular markings, and compression of the unaffected lobes, on the side of involvement. Finally there may be herniation of the emphysematous lobe into the opposite hemithorax. Fluoroscopy shows diminished motion of the depressed diaphragm and of the separated bronchovascular markings. The displaced heart and mediastinum may swing to the affected side with inspiration. The need for accurate diagnosis and prompt surgical intervention in most cases is stressed.

One case is reported.

Two roentgenograms. GORDON L. BARTEK, M.D.
Grand Rapids, Mich.

Silicosis and Bronchogenic Carcinoma. H. Weissman. Am. Rev. Tuberc. **76**: 1088–1093, December 1957.

Two cases of silicosis are reported in patients in whom bronchogenic carcinoma was also present—one squamous-cell and the other undifferentiated. This association of silicosis and bronchogenic carcinoma is infrequent and a number of reports have been published indicating that the incidence of carcinoma in silicotics is distinctly less than in the general population. The author believes that the theory that silicosis protects against bronchogenic carcinoma should be investigated because of the infrequency of the occurrence of the two diseases in association.

Three roentgenograms. JOHN H. JUHL, M.D.
University of Wisconsin

Pulmonary Alveolar Microlithiasis Associated with the Inhalation of Snuff in Thailand. Ninart Chinachoti and Prasan Tangchai. Dis. of Chest **32**: 687–689, December 1957. (Nunburi Tuberculosis Hospital, Bangkok, Thailand)

During a routine chest x-ray survey in Bangkok, abnormal pulmonary shadows were discovered in 9 men who were strongly addicted to the inhalation of snuff. Three years later pulmonary symptoms developed in one of these men, and he died following pneumothorax incident to needle biopsy of the lung. Autopsy disclosed typical pulmonary alveolar microlithiasis. The patient had taken snuff for twenty-three years, about 7.5 gm. per day in divided doses two to three hours apart. The snuff contained 9.47 per cent calcium. The authors believe that the lesions in this case and certain others may have resulted from a hyperimmune reaction to an inhaled irritant as suggested by Kent *et al.* (Arch. Path. **60**: 556, 1955. Abst. in Radiology **67**: 449, 1956).

One roentgenogram; 1 photomicrograph.

Localized Amyloid Tumors of the Tracheobronchial Mucosa. J. Delarue, J. Pointillart, J. P. Garaix, and Mme. Verley. J. franç. méd. et chir. thorac. **11**: 416–425, 1957. (In French) (Hospice Paul-Brousse, Paris, France)

This is a case report and discussion of an unusual condition in which a localized plaque of tumor-like tissue forms in the trachea or bronchi and bronchoscopy and biopsy yield a diagnosis of an inflammatory mass. These patients may have the symptoms and signs of tracheobronchial obstruction but sometimes there is merely a history of irritation, with episodes of coughing and other features leading to a diagnosis of bronchitis. Most of the patients have been between thirty and fifty years of age, but autopsies have been reported on subjects of sixty-three to seventy. The presence of a long standing lesion in the tracheobronchial tree apparently leads to bronchiectasis in some patients. The amyloid masses may be removed through the bronchoscope.

It is important to realize that these localized amyloid tumors do not form a part of generalized amyloid disease. They may occur on the conjunctiva, tongue, skin, and even the fallopian tubes. Histologically, the cellular reaction around the amyloid mass is almost like a foreign-body reaction.

Five photomicrographs.

CHARLES M. NICE, JR., M.D.
Tulane University, New Orleans, La.

Mucoid Impaction of the Bronchi. A Study of Thirty-Six Cases. Robert R. Shaw, Donald L. Paulson, and John L. Kee, Jr. Am. Rev. Tuberc. **76**: 970–982, December 1957. (Baylor Hospital, Dallas, Texas)

Mucoid impaction of the bronchi usually occurs in patients with bronchial asthma. The essential feature

is a glairy, greenish-gray endobronchial mass of mucoid material which may reach a length of 1 to 3 cm. and a diameter of 1 to 2.5 cm. The impactions occur in second-order branch bronchi distal to the bifurcation and are often found in pairs. The adjacent bronchial wall becomes dilated and later infected. The cartilaginous elements are usually destroyed, and the epithelial lining of the bronchus undergoes squamous metaplasia. Suppuration distal to the blocked bronchus may be in the form of pneumonitis, abscess formation, or cystic bronchiectasis. The alveoli are filled with amorphous eosinophilic material which contains plasma cells, lymphocytes, eosinophils, and occasionally giant cells. Fat may be found in the epithelial cells. The findings may suggest an erroneous diagnosis of lipoid granuloma or eosinophilic granuloma of the lung. The authors believe that patients with the clinical entity of mucoid impaction of the bronchi have also been diagnosed as having Loeffler's syndrome. The symptoms are similar in the two conditions and roentgenograms of patients reported as having Loeffler's syndrome have resembled those of mucoid impaction.

Thirty-six patients comprise the present series, 30 of whom had bronchial asthma, hay fever, or chronic obstructive bronchitis. Twenty-six had cough productive of purulent sputum and 16 remembered having coughed up hard rubbery plugs of mucus. After expulsion of the plugs, drainage of purulent material usually occurred, followed by improvement of symptoms. Pleuritic pain was present in 17 cases, and in 11 there were episodes of hemoptysis. Mucoid impaction in the bronchi should therefore be considered in any patient with a history of asthma who complains of persistent or recurrent cough associated with purulent sputum, pain, or hemoptysis.

The roentgenographic findings are somewhat varied, but the usual appearance is that of segmental obstruction with density produced by the mucoid matter itself and the granulomatous process or bronchiectasis distal to the plug. Occasionally a sharply circumscribed nodule may be the only roentgen evidence of the condition. There may be formation of an abscess distal to the bronchial obstruction. The plugs are much more common in the upper than in the lower lobes. In the present series the upper lobes were involved in 24 of the patients; the lower lobes in 5 and the lingula, or middle lobe, in 3. The remaining patients had multiple areas of involvement. Bronchography may reveal the obstruction and may also demonstrate areas of cystic bronchiectasis in adjacent segments which have been involved earlier by a similar obstructing impaction of mucus.

Some of the patients had masses which could not be distinguished from neoplasms, and surgery was done to establish the diagnosis. In others resectional surgery was done for relief of symptoms. Sixteen of 19 patients followed for a significant period of time after resection were definitely improved. Fourteen patients treated only by medical measures showed little improvement.

Fourteen roentgenograms; 1 photograph; 6 tables.

JOHN H. JUHL, M.D.
University of Wisconsin

Rheumatoid Lung. Barbara Read. Proc. Coll. Radiologists Australasia **1**: 77–80, December 1957. (School of Radiology, R. P. A. Hospital, Sydney, N. S. W., Australia)

A case is reported to illustrate the lung changes which may be associated with rheumatoid arthritis. The author quotes Rubin's description of the radiological findings (Am. J. Med. **19**: 569, 1955. Abst. in Radiology **67**: 291, 1956).

"The infiltrations may be small and evenly distributed, simulating miliary tuberculosis, or they may be of a nodular character affecting chiefly the mid and lower lung fields, simulating sarcoidosis, inhalational dust disease, or bronchogenic tuberculosis, or they may be irregular, of patchy distribution simulating viral or bacterial bronchopneumonia.

"After subsidence of the acute stage of the disease, the markings assume a more linear configuration of a delicate or coarse reticular network such as one sees in lymphangitic carcinomatosis or diffuse interstitial fibrosis of the lungs. In long standing disease, secondary bronchopneumonia and suppuration tend to obscure the basic pattern."

The pathological appearances in the lungs are identical with those of the Hamman-Rich syndrome. The author's patient died of a myocardial infarction, and at autopsy there was found, in addition to the diffuse fibrosis, a thick-walled ragged abscess.

Four roentgenograms.

GORDON L. BARTEK, M.D.
Grand Rapids, Mich.

THE HEART AND BLOOD VESSELS

Angiocardiographic Glimpses of Cardiac Physiology. Melvin M. Figley. Am. J. M. Sc. **234**: 613–630, December 1957. (Department of Radiology, University of Michigan, Ann Arbor, Mich.)

Although the principal usefulness of venous angiocardiography lies in its anatomical implications, certain physiologic processes may be studied. The procedure may be correlated with electrocardiography, phonocardiography, and electrokymography. It is possible even with simple venous injection and rapid filming equipment to show changes in contraction of heart chambers, movement of blood, and the action of valves.

Under optimum conditions venous angiocardiography produces very little disturbance in resting hemodynamics during the filming period. Numerous authors have established the patterns of atrial and ventricular contractions, both right and left, in conjunction with the complexes of the electrocardiogram. Correlation with phonocardiography permits a fuller appreciation of the cyclic variations in heart morphology.

Present-day biplane angiocardiography will allow measurement of ventricular volumes and in the future it may be possible to compute end diastolic volume, systolic residual blood, stroke volume, and cardiac output by this method.

Atrioventricular heart block provides an example of exaggerated stroke volume. Constrictive pericarditis is distinguished by low fixed stroke volume. It is interesting that there is no vena caval constriction in the latter condition, since these vessels are consistently dilated. The manner of contraction of the infundibulum of the right ventricle serves to differentiate pulmonic valvular stenosis and infundibular stenosis.

The problem of distinguishing mitral stenosis and insufficiency has been studied. Atrial emptying is impaired in mitral stenosis, occurring slowly during early ventricular diastole, when it is normally rapid, and to a relatively greater extent than normal during atrial systole. The converse is true in mitral insufficiency.

Abnormalities may be encountered in the movement of blood in respect to velocity and direction of flow. The relation between heart volume and stroke volume appears critical in alterations of circulation velocity. Abnormalities in direction of flow are of more practical importance at the present time. Shunts, both right-to-left and left-to-right, may be shown, especially by selective angiocardiography.

Tricuspid and pulmonary valvular function may be precisely established by right heart catheterization. Mitral and aortic variations may be better visualized by pulmonary artery catheterization and injection or by injection through a needle inserted into the left atrium or ventricle. Valvular incompetency must be evaluated by injection of a contrast substance into the chamber distal to the valve concerned.

Twenty-four roentgenograms; 4 diagrams; 3 electrocardiograms. JOHN F. RIESSER, M.D.
Springfield, Ohio

The Importance of the Shape and Size of the Heart. Editorial. A. C. Burton. Am. Heart J. **54:** 801–810, December 1957. (Department of Biophysics, University of Western Ontario, London, Canada)

In this editorial the author attempts to apply classical laws of physics (notably the law of Laplace) to the functioning of the human heart.

The law of Laplace applies to a "membrane" separating two spaces of any shape, that has a "tension" within it. According to this law, if a "slit" were cut in the membrane, the edges would pull apart with a certain force. The wall of the ventricle is considered as such a membrane, and in systole there is a "tension" in the muscle. There is also a difference of pressure *across* the membrane between the "inside" and "outside" of the ventricle. In systole this difference of pressure is equal to the ventricular systolic blood pressure. The law of Laplace states that the difference of the pressure across the membrane (or muscle) is related to the tension in the membrane by an equation involving the shape of the membrane (that is, its curvature).

In experiments on necropsy hearts, Woods estimated the radii of curvature for a number of points and concluded that the thickness of the ventricular wall at any point is proportional to the tension that the wall could develop in systole. Laplace's law thus explains the variation in thickness of different parts of the same chamber. In the curved parts of the ventricle, such as the apex, the tension is maintained even though the wall is thin. In the more "flat" parts the wall must be thick in order to maintain sufficient tension. The same law applies to the curve of the arch of the aorta. In this case there is an increase in the elastic tissue in the wall on the greater curvature of the arch.

In regard to the size of the heart: if the heart were very large, the force that it would have to develop in its wall to maintain the normal systolic pressure would be greatly increased. The dilated heart, therefore, is at a great disadvantage compared to the heart of normal size. In addition, according to Starling's law, there is an increased force of contraction with increase in length of the muscle fibers. This law eventually fails when a critical length is reached. This is also an important factor in heart failure.

A dilated heart may continue to do a normal amount of "external work," but its efficiency is cut down. The energy and oxygen requirements go up immediately when the tension of the cardiac muscle increases.

Visscher and co-workers have concluded from their work that the oxygen consumption of the heart depends upon the diastolic volume and is not dependent on the external work that the heart does. The law of Laplace thus explains why diastolic size affects energy turnover by increasing the tension and time factors. The external work of the heart is apparently of less importance.

An increase in heart rate increases the total load. An increase in systolic pressure (as in hypertension) will increase the tension required in the heart muscle. If dilatation eventually occurs, the tension will increase even further.

The author concludes that the size of the heart, heart rate, and systolic pressure are probably the best indices of cardiac stress.

Four diagrams; 1 table. ROGER M. STOLL, M.D.
New York, N. Y.

On Methods and Complications in Catheterization of Heart and Large Vessels, With and Without Contrast Injection. Marianne Bagger *et al.* Am. Heart J. **54:** 766–777, November 1957. (Stockholm, Sweden)

The collected experiences of 35 authors in 12 hospitals concerning methods and complications in catheterization of the heart and large vessels, with and without contrast substance, reveals 23 deaths (19 certainly connected with the procedure and 4 uncertainly) in a total of 8,817 examinations, an incidence of 0.26 per cent. These deaths are broken down as follows: 8 in 5,859 right heart catheterizations (0.136 per cent) and 15 in 2,958 (0.507 per cent) examinations which included angiocardiography, angiopulmography, and thoracic aortography. The 4 patients whose deaths could not be attributed unquestionably to catheterization were in serious condition and the primary disease could have been responsible for the fatal outcome. Three of the patients were not considered seriously ill, but in 1 of these a fresh myocardial infarct was found postmortem. Causes of death are listed as ventricular tachycardia or fibrillation in 2; cardiac standstill in 6; heart failure in 3. In 4, the anesthesia contributed to the fatal result. In 1 air embolism was a possible cause; in another, anuria and septic thrombo-embolism; in another vertebral artery thrombosis and cerebellar necrosis; and in still another cerebral and renal contrast embolism.

In two hospitals special technics were employed. In one, left atrial puncture was performed by way of a paravertebral approach in 167 patients having mitral or aortic valvular disease, with 1 fatal outcome due to cardiac tamponade and ventricular fibrillation and 13 complications without fatal outcome. In the other hospital, left atrial puncture was performed by way of a suprasternal route in 197 patients with 1 fatality.

Transient complications of right heart catheterization, aortic arch catheterization, and angiocardiography were reported as follows: ventricular fibrillation 2; ventricular tachycardia 8; auricular tachycardia 7; auricular flutter 13; syncope 6; right bundle branch block 18; total A-V block 5; intravasal catheter knot 6; endomyocardial damage 6; severe arterial spasm 1; heart failure 12; heart wall perforation 1; arterial embolization 1; severe febrile reaction 2; severe thrombophlebitis 3; lung infarction 4.

The performance of heart catheterization, angiocardiography, and similar examinations should be concentrated in the large hospitals where a diagnostic unit with experienced examiners and good technical

equipment can be organized, and where are present also those other special units which are needed for collaboration and for full use of the special information obtained by the diagnostic procedures.

During the course of the fluoroscopic examination incident to the catheterization, the examiner may receive 1.5 to 6 mr/min. to arms and legs and less than 0.2 mr/min. to body and neck, while the patient may receive 1 to 8 mr/min. The examiner may receive 100 mr per examination and should be restricted to two or possibly three such examinations per week so as not to exceed the maximum permissible amount of radiation (300 mr/week).

Three tables. HENRY K. TAYLOR, M.D.
New York, N. Y.

Ebstein's Anomaly. Presentation of Ten Cases. Florence E. Mayer, Alexander S. Nadas, and Patrick A. Ongley. Circulation **16:** 1057–1069, December 1957. (Children's Medical Center, Boston, Mass.)

The abnormal physiology associated with Ebstein's anomaly is caused by downward displacement of the origin of one or more of the leaflets of the tricuspid valve. This results in encroachment on the outflow tract of the right ventricle and interference with its function.

On plain films considerable enlargement of the heart is seen, mainly to the right, with a poorly delineated pulmonary artery and diminished pulmonary vascular markings. Angiocardiography demonstrates the huge right atrial chamber, which empties slowly. The pulmonary artery and its branches are poorly opacified. A right-to-left shunt is demonstrable in about half the cases.

Cardiac catheterization is somewhat hazardous in this condition, giving rise to dangerous arrhythmias as the catheter reaches the tricuspid valve (deaths have been reported as a result of the procedure). If performed, catheterization shows the enlargement of the atrium, displacement of the tricuspid valve to the left, some elevation of atrial pressure, but normal pressures beyond this point.

Clinically there is a picture of normal growth, dyspnea, easy fatigability, palpitations, and some degree of cyanosis. Heart sounds and murmurs may vary, but electrocardiographic findings are fairly consistent. P waves are prominent, with delayed A-V conduction, bundle branch block, and low amplitude right ventricle potentials.

The authors discuss their observations in 10 cases, and furnish a good review of the literature. They point out that diagnosis of this lesion is important to avoid unnecessary and hazardous surgery.

Six roentgenograms; 5 photographs; 2 electrocardiograms; 2 phonocardiograms; 1 diagram; 2 tables.
ZAC F. ENDRESS, M.D.
Pontiac, Mich.

The Definitive Diagnosis of Effusive or Constrictive Pericarditis. Louis A. Soloff and Jacob Zatuchni. Am. J. M. Sc. **234:** 687–695, December 1957. (Temple University School of Medicine and Hospital, Philadelphia, Penna.)

Conventional roentgenologic means, clinical evaluation, and cardiac catheterization may not afford enough evidence to establish the diagnosis of effusive or constrictive pericarditis. Angiocardiography permits a simple differentiation of the two and also allows an analysis of the relative contributions of myocardial and pericardial factors in the production of cardiac disability. Intravenous carbon dioxide injection with the patient in the left lateral decubitus position, followed by horizontal-beam roentgenography, is another means of recognizing effusion and constrictive pericarditis.

The angiocardiographic diagnosis of pericardial effusion depends upon the demonstration of homogeneous density surrounding the opacified heart. It is adjacent to all of the heart borders but thickest on the sides. Neoplasm, cyst, or abscess may also produce an extrinsic density but this is usually asymmetrical or irregular. The heart itself is not deformed, the venae cavae are dilated, there is reflux into the inferior vena cava from the right atrium, the pulmonary artery and its branches are elevated by the underlying effusion, the left ventricle is pushed forward, and there is occasionally a normal intracardiac circulation time. Prolonged circulation time suggests myocardial dysfunction.

The pathognomonic finding of constrictive pericarditis is a rigid right atrial border which has lost its convexity. The effect of restriction of the heart is seen in dilatation of the vena cava, pulmonary vessels, and atria. The intracardiac circulation time is variable. Persistent prolongation of the circulation time is an ominous sign following adequate therapy. At surgery, when decortication is attempted, plaques are found which are impossible to remove. Neither prolongation of circulation time nor a rigid right atrial wall should contraindicate surgery, since improvement has been obtained by operation, rather they indicate myocardial dysfunction which may persist postoperatively either because of our present inability to decorticate the heart adequately or because of associated irreversible myocardial disease.

Three case reports are presented.

Eight roentgenograms. JOHN F. RIESSER, M.D.
Springfield, Ohio

Diverticulum of the Pericardium, with Observations on Mode of Development. Herbert C. Maier. Circulation **16:** 1040–1045, December 1957. (Lenox Hill Hospital, New York, N. Y.)

Two cases of pericardial diverticula are presented. In both cases the lesion presented on the right side and both were confirmed by surgery. One patient gave a history of acute pericarditis six years earlier. In the second case the diverticulum was very small and associated with a pleuropericardial cyst.

The density on the roentgenogram produced by a pericardial diverticulum is inseparable from that of the cardiac silhouette. The shape and location of the abnormal shadow may vary widely, and there may be considerable change in the shape dependent upon respiration and position. Except for pneumopericardium, which would appear to be undesirable as a diagnostic procedure, the only absolute roentgen sign of a pericardial diverticulum is disappearance of the cystic mass or conclusive evidence of diminution in its size when the patient is so positioned—as in lateral recumbency—that the diverticulum lies above the pericardium. Some of the fluid may then drain back into the pericardium. Change in the volume of the cystic lesion is, however, difficult of exact interpretation.

Pericardial diverticula have not been reported in infants, and most cases are associated with effusions, leading the author to believe that the lesion is acquired

rather than congenital, caused by a "blowing-out" of a weak spot in the fibrous outer layer of the pericardium.

Six roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Intrapericardial Bronchogenic Cysts; Report of Two Cases and Probable Embryologic Explanation. C. Harwell Dabbs, Ralph Berg, Jr., and E. Converse Peirce, II. J. Thoracic Surg. **34:** 718–734, December 1957. (C. H. D., Acuff Clinic, Knoxville, Tenn.)

Two histologically proved cases of intrapericardial bronchogenic cysts are reported. The first patient, a 42-year-old woman, had occasional ankle edema and dyspnea. The tumor was discovered on a chest film at the time of a respiratory infection. The second patient, a 20-year-old woman, was asymptomatic and was studied because of an abnormal routine chest film.

Radiographic findings were similar, showing an oval mass inseparable from the upper part of the right heart border, lying anteriorly and containing lamellar and amorphous calcification. Angiocardiograms in Case 2 demonstrated displacement of the superior vena cava to the right, of the right atrium inferiorly, and of the right ventricle inferiorly and to the left. Surgery in each instance showed a multiloculated cystic tumor within the pericardium, arising between the root of the aorta and the superior vena cava, and dissecting between the atria.

The authors review 20 additional cases of multiloculated cystic intrapericardial tumors found in the literature; some were teratomas but most of them should probably be classified as bronchogenic cysts.

Ten roentgenograms; 4 photomicrographs; 4 photographs; 5 drawings; 1 table.

GARTH R. DREWRY, M.D.
Oakland, Calif.

Coarctation of the Abdominal Aorta at the Origin of the Inferior Mesenteric Artery. Report of a Case Diagnosed by Translumbar Aortography. Tawan Surawongse Bunnag. Am. J. Roentgenol. **78:** 1003–1006, December 1957. (Chulalongkorn Hospital, Thai Red Cross Society, Bangkok, Thailand)

A 22-year-old Siamese female gave a history of intermittent claudication for several years before admission. A systolic murmur and thrill were heard at the level of the umbilicus; there were no pulsations in the arteries of the lower legs and blood pressure in the lower extremities was markedly decreased. Roentgenograms taken after injection of 70 per cent Urokon into the aorta at the level of L-1 showed aortic narrowing between the level of L-2 and L-3 for a distance of about 4 cm. The coarctation included the origin of the inferior mesenteric artery and the arteries of L-3. This is said to be the thirteenth reported case of coarctation of the abdominal aorta diagnosed by translumbar aortography.

Three roentgenograms. D. D. ROSENFELD, M.D.
Fontana, Calif.

Pulmonary Artery Ring. H. G. Hiller and A. D. Maclean. Acta radiol. **48:** 434–438, December 1957. (Department of Radiology, Royal Children's Hospital, Melbourne, Australia)

The findings of stridor, wheeze, and repeated respiratory infections in infants and young children bring to mind the possibility of a vascular ring. All these symptoms are intensified by respiratory infections and usually increase during feedings. Heretofore the prime consideration, once a vascular ring has been suspected, has been an aortic ring. The authors report 3 cases of pulmonary vascular ring, in none of which was there an acute onset of presenting symptoms.

In this condition the left pulmonary artery arises to the right of the midline, passing back and then to the left between the trachea and esophagus to the left lung. This anomalous course results in marked anterior indentation of the esophagus, which is best demonstrated in the lateral view following a barium swallow. The same view may show some posterior encroachment on the lowermost trachea.

Of the authors' 3 patients, 2 underwent surgery. One of these died in the immediate postoperative period, while the second survived and showed a disappearance of the pressure defect on the esophagus as well as a clearing of symptoms.

Eight roentgenograms. SAUL SCHEFF, M.D.
Boston, Mass.

Multiple Pulmonary Stenoses with Pulmonary Hypertension. Report of a Case. J. Dighiero, O. Fiandra, A. Barcia, R. Cortés, and J. Stanham. Acta radiol. **48:** 439–443, December 1957. (J. D., Cardiac Laboratory, University Hospital, Montevideo, Uruguay)

The authors report a case with multiple stenoses in the pulmonary artery branches with associated hypertension in the lesser circulation. Such hypertension, particularly in children, indicates the necessity of a thorough work-up, including angiocardiography, before the case is labeled as primary or idiopathic.

The case reported was investigated because of a very loud murmur, parasternal click, and systolic thrill in the left 3rd and 4th interspaces. Routine chest films showed the heart to be normal in transverse diameter, with the right ventricle enlarged in the lateral view. There was clockwise rotation, hiding the aorta in the frontal view. The left pulmonary artery was easily seen and did not appear dilated. Vascularity was diminished and irregular especially in the central and upper portions of the lungs. Pulmonary function tests were unrewarding.

Cardiac catheterization revealed normal oxygen saturation and hemoglobin levels. The cavities explored had normal pressures until the right ventricle was reached. Here there was hypertension (107 mm. Hg), as also in the pulmonary artery (55 mm. Hg), showing a markedly increased pressure gradient between these two chambers. The catheter passed into the left atrium through a patent foramen ovale.

Angiocardiography, with the catheter introduced into the right ventricle through the right internal saphenous vein, showed the right ventricle to be hypertrophied and trabeculated. The cusps in systole had the characteristic appearance associated with valvular pulmonary stenosis, bowing upward like a dome, leaving the sinuses of Valsalva collapsed along the boundary. Concomitantly there was narrowing of the outflow tract. The main pulmonary artery and its chief branches appeared hypoplastic and in the secondary branches there were multiple stenotic areas with poststenotic dilatation noted in one area. The vessels to the right upper lobe were coincidentally depressed by a zone of emphysema.

Six roentgenograms. SAUL SCHEFF, M.D.
Boston, Mass.

Arteriosclerosis and Renal Hypertension: Indications for Aortography in Hypertensive Patients and Results of Surgical Treatment of Obstructive Lesions of Renal Artery. Eugene F. Poutasse and Harriet P. Dustan. J.A.M.A. **165:** 1521–1525, Nov. 23, 1957. (E. F. P., 2020 E. 93rd St., Cleveland 6, Ohio)

Obstructive renal artery disease, unilateral or bilateral, was found in 30 patients out of a total of 104 subjected to translumbar aortography because of hypertension. These obstructive lesions were in most instances considered the primary cause of the hypertensive disease, although some aggravated pre-existing essential hypertension. In 23 cases the obstruction was the result of an atherosclerotic plaque. The additional 7 cases included fibrous intimal proliferation, embolus, thrombosis, and arteriosclerosis associated with pyelonephritis. Post-stenotic aneurysmal dilatation, potentially dangerous because of the possibility of rupture, was found in 6 patients.

Aortography was not used as a routine in all hypertensive patients. It was considered to be indicated (1) in the presence of unexplained disparity in size (as little as 1 cm. in length) or function of the kidneys on intravenous urography; (2) in young patients who did not seem to have essential hypertension or other demonstrable cause for hypertension; (3) in elderly hypertensive patients with sudden development of accelerated or malignant hypertension; (4) in patients of any age with long-standing essential hypertension that abruptly became more severe, particularly with a history of preceding flank pain that might be due to subtotal renal infarction.

Of the 30 patients found to have hypertension associated with renal disease, 19 were subjected to various surgical procedures. Postoperatively 11 had normal blood pressure; 6 were improved but blood pressure was not normal; 1 died from postoperative hemorrhage and 1 from kidney failure with incurable arteriosclerosis of the renal artery and its branches in a solitary kidney.

Nephrectomy is the treatment of choice for relief of hypertension due to unilateral renal artery obstructive disease when the involved kidney shows distinct atrophy and reduced function. Other procedures include segmental aortic homografts with attached renal arteries, excision of constricted segments, and endarterectomy for eccentric plaques. Antipressor drugs are used postoperatively in some patients for prompt reversal of hypertension and are then gradually withdrawn.

The authors conclude that the most important means of recognizing renal artery disease is renal angiography accomplished by translumbar aortography.

One roentgenogram; 1 photograph; 2 tables.

B. JAY HILL, M.D.
University of Michigan

A True and a False Arteriosclerotic Aneurysm of the Subclavian Artery. Israel Steinberg. Am. J. Roentgenol. **78:** 1007–1012, December 1957. (525 East 68th St., New York 21, N. Y.)

The author presents 2 cases of subclavian artery aneurysm occurring in elderly women. This abnormality is rare but may be expected to occur with increasing frequency as longevity increases and a rise in arteriosclerosis occurs. The report correlates the clinical and roentgen features of arteriosclerotic subclavian artery aneurysms and attempts to establish criteria for the diagnosis during life.

Both patients exhibited widespread atherosclerosis of the aorta and peripheral branches. In one, there was a true although incidental aneurysm of the left subclavian artery, with death following abdominal surgery that disclosed an inoperable abdominal aortic aneurysm. In the other, a false superior mediastinal aneurysm resulted from rupture of an arteriosclerotic plaque in the right subclavian artery. Death was due to asphyxiation from a mediastinal and right pleural hematoma. In case one (true left subclavian artery aneurysm), significant clues were present in the chest roentgenogram. These consisted of tortuosity of the brachial-cephalic artery, a calcified mass at the origin of the subclavian artery, and linear calcification along the route of the subclavian artery. Clinically, there was absence of the left pulse. Poor condition of the patient prevented definitive diagnostic studies such as angiocardiography.

In the second case (false superior mediastinal aneurysm) the chest roentgenograms demonstrated an enlarged right superior mediastinal mass, calcific plaques in the right subclavian artery, and widespread generalized peripheral arteriosclerosis. Clinical findings of significance in this case were fever of unknown origin, a change in voice, and evidence of tracheal compression. Angiocardiography was recommended but could not be done because of the condition of the patient. It is doubtful that the false aneurysm could have been diagnosed by routine roentgenography.

The diagnosis of brachial-cephalic artery aneurysms is important because of their tendency to rupture. Present-day advances in surgery, with resection and replacement by homologous grafts, provide increasing stimulus for early recognition that may be life-saving.

Five roentgenograms; 3 photographs.

NORMAN L. ARNETT, M.D.
Upland, Calif.

Axillary Artery Thrombosis in Muscular Dystrophy. J. P. Murray. Brit. J. Radiol. **30:** 660–662, December 1957. (David Lewis Northern Hospital, Liverpool 3, England)

This paper is a brief review of the etiology of vascular thromboses associated with costoclavicular compression. The author is of the opinion that arterial thrombosis is essentially a traumatic thrombosis and cites the work of Eden (Brit. J. Surg. **27:** 111, 1939. Abst. in Radiology **34:** 645, 1940) to support this theory. Eden compiled from the literature 45 cases of vascular complications due to cervical rib or first thoracic rib abnormality, with operative findings in 3 additional cases. In each of his cases the subclavian artery was surrounded by dense fibrous tissue at the site of compression. Intermittent compression and the dense fibrosis was believed by Eden to lead to thrombosis of the intima, with embolus formation in the smaller vessels of the hand and forearm.

The author reports a case of bilateral axillary artery thrombosis in a 44-year old male, similar to those described by Eden. Sagging of the shoulders due to muscular dystrophy led to intermittent compression of the subclavian artery between the clavicle and the first rib.

The patient experienced a sudden pain in his right arm, extending into the elbow and radiating to the fingers. An arteriogram showed a block of the axillary artery. On physical examination there was noted to be an absence of the radial pulse in the left arm and obstruction of the axillary artery on this side was also

demonstrated. In retrospect the patient could not remember having any symptoms of pain in the left upper extremity. He gradually improved on conservative therapy and surgical exploration of the right supraclavicular fossa was not accomplished.

The author believes that percutaneous subclavian arteriography is now a relatively safe and simple procedure and should be used in the investigation of cases in which costoclavicular vascular compression is suspected.

Six roentgenograms. J. P. CHAMPION, M.D.
Grand Rapids, Mich.

Vertebral Arteriography by Percutaneous Puncture of the Subclavian Artery. P. L. Barbieri and G. C. Verdecchia. Acta radiol. **48:** 444–448, December 1957. (Roentgen Department, Umberto I Polyclinic, Rome, Italy)

At the present time there are four common methods of performing vertebral arteriography: (1) percutaneous injection of the artery in its intraosseous course; (2) catheterization of the vessel *via* the radial artery; (3) percutaneous puncture in the occipito-atlantal region; (4) injection through a catheter introduced by way of the femoral artery into the subclavian.

The authors describe still another method, consisting in the percutaneous injection of the subclavian artery in the supraclavicular fossa, which is not without advantage. They found the blood output of the subclavian and vertebral arteries to have an average relationship of 4:1 and therefore consider it safe to inject 15 ml. of 70 per cent Fortomobrine in adults of average size. The necessary increase in injection time is compensated by reducing the output of the subclavian artery by placing a hemostatic clamp around the axillary artery. The injection is performed preferably on the left side to avoid simultaneous filling of the carotid artery. After general anesthesia, the vessel is localized by direct palpation with the neck flexed to relax the anterior muscles.

The advantages of this procedure, as noted in 15 punctures performed by the authors—all well tolerated—include the easy accessibility of the subclavian artery and the avoidance of direct trauma to the vertebral artery. Mixing of the medium with blood in the subclavian is more or less physiological and still results in a good concentration in the vertebral artery without an increase in pressure in the latter vessel.

Nine roentgenograms. SAUL SCHEFF, M.D.
Boston, Mass.

Transcostal Phlebography. S. Szucs and G. Miskovits. J. franç. méd. et chir. thorac. **11:** 344–354, 1957. (In French) (Budapest, Hungary)

Transcostal phlebography is performed by the injection of 20 to 30 ml. of contrast material into the marrow of the the seventh, eighth, and ninth left ribs in the midaxillary line, with the exertion of only moderate pressure during the injection. A needle of 2 to 3 mm. bore is used. The intercostal, mammary, diaphragmatic, lateral thoracic, and azygos-hemiazygos systems of veins are opacified. The chief importance of transcostal phlebography is considered to be in the possible differential diagnosis of thoracic tumors and in determining operative possibilities. No untoward effects have been seen in nearly 100 cases.

Thirteen figures, including 11 roentgenograms.
CHARLES M. NICE, JR., M.D.
Tulane University, New Orleans, La.

THE DIGESTIVE SYSTEM

The Effects of Sustained Deep Inspiration on the Normal Lower Esophagus and Phrenic Ampulla in Erect Adults. Bernard S. Epstein. Am. J. Roentgenol. **78:** 1013–1019, December 1957. (Long Island Jewish Hospital, New Hyde Park, N. Y.)

The author studied the distal esophagus of 100 normal adults in the erect position, with particular attention to its behavior after sustained inspiration. In 40 per cent of the patients there was no gross delay in the passage of barium after inspiration and no formation of a phrenic ampulla. The remaining patients showed a transient, variable dilatation of the distal esophagus which the author considered to be the phrenic ampulla. Demonstration of the ampulla did not depend on the position of the patient or excessive filling of the distal esophagus with fluid and could be shown in some patients with only partial filling. Horizontal bands were observed in the midportion of the ampulla in 5 patients, corresponding in location to the esophageal rings described by others (see for example Schatzki and Gary: Am. J. Roentgenol. **75:** 246, 1956. Abst. in Radiology **67:** 902, 1956), but none of these patients had dysphagia. The author believes that the formation of the ampulla and ring are neuromuscular changes incident to the effects of deep inspiration rather than related to muscular action of the diaphragm.

Eighteen roentgenograms.

D. D. ROSENFELD, M.D.
Fontana, Calif.

Neuromuscular Imbalance of the Esophagus Associated with Hiatal Hernia as Studied by Means of Cinefluorography and Intraluminal Pressure Recordings. Frederick S. Cross, Earle B. Kay, and George F. Johnson. J. Thoracic Surg. **34:** 736–748, December 1957. (St. Luke's Hospital, Cleveland, Ohio)

Fifty-five patients with esophageal problems including neuromuscular failure, segmentation, achalasia, diverticula, and hiatal hernia were studied by routine fluoroscopy, esophagoscopy when feasible, intraluminal pressure studies, and cinefluorography. Normal patterns of esophageal activity were established. Baseline pressures are positive in the pharynx, negative in the thoracic esophagus, fluctuating in the vestibular area, and positive in the stomach. During swallowing the glossopharyngeal muscle contracts, the cricopharyngeus muscle relaxes, and a peristaltic wave passes through the esophagus, diminishing caudally.

"Neuromuscular failure," with low base pressures in the cricopharyngeal area, indicating muscle hypotonicity and weak peristaltic contractions, may be an isolated finding, especially in elderly debilitated people. Fluoroscopic and cinefluorographic studies show great delay, sometimes more than three minutes, in passage of barium through the esophagus to the stomach when the patient is supine.

A second form of neuromuscular imbalance is termed "segmentation." This represents a hyperactive, hypertonic condition of the cricopharyngeus area and the lower two-thirds of the esophagus, while the upper third is normal or hypoactive. Barium progresses normally through the upper one-third, but there is segmentation and in-co-ordinated churning of barium in the lower esophagus, accompanied by significant dysphagia.

In some cases of hiatal hernia, especially small uncomplicated ones, the esophageal motility was normal.

More frequently, the hypoactive pattern described for neuromuscular failure was found. In addition, the transitional zone between the positive base pressure normally occurring in the stomach and the negative base pressure in the esophagus is at a higher esophageal level than normal. The hyperactive motility pattern associated with segmentation was not found in association with hiatal hernia. However, a hyperactive inferior esophageal constrictor, or so-called contraction band, was frequently present and sometimes was an important clue to the presence of a small hiatal hernia. This altered peristalsis can explain symptoms of dysphagia out of proportion to the size of the hiatal hernia.

Ten figures, including 4 roentgenograms.

GARTH R. DREWRY, M.D.
Oakland, Calif.

Gastroesophageal Incompetence—Its Relationship to Short-Esophagus Type of Hiatal Hernia in Infancy. Maurice Tatelman and Irving F. Burton. Gastroenterology **33:** 991–997, December 1957. (M. T., Detroit Memorial Hospital, Detroit 26, Mich.)

While a single case seldom proves a point, the authors feel that their report provides good clinical and radiological evidence that the short-esophagus hiatal hernia may result from persistent gastroesophageal regurgitation during infancy when no such hernia could be shown at birth. Their patient vomited persistently in the neonatal period, and roentgen examination on the eighth day of life demonstrated gastroesophageal incompetence with reflux esophagitis, the esophageal folds beings coarse and irregular.

Initial therapy was conservative. The infant was fed in the sitting position and so maintained for one hour postprandially. After three weeks on this régime reexamination showed a decrease in the degree of esophagitis and revealed a moderate-sized sliding-type (axial) hiatus hernia. At four months of age the hernia was surgically reduced and the relaxed esophageal hiatus was repaired. Repeated x-ray studies thereafter failed to show either gastroesophageal regurgitation or hiatus hernia.

Six roentgenograms.

SAUL SCHEFF, M.D.
Boston, Mass.

The Prepyloric Contractions in the Normal Stomach. A. D. Keet, Jr. Acta radiol. **48:** 413–424, December 1957. (Groote Schuur Hospital, Cape Town, Union of South Africa)

Roentgenographic and fluoroscopic examinations of the stomach were performed in 320 normal persons in order to study the prepyloric contractions. The ages of the subjects ranged from nine to eighty years, the majority being in the thirty-to-sixty-year group. An equal number of males and females were studied.

In the body of the stomach, peristalsis occurs as a ring-like contraction of the muscularis propria moving toward the bulb. When it reaches the prepyloric region this contraction stops and a concentric contraction in the prepyloric portion begins under the influence of three muscles. The first is a muscular loop surrounding the pyloric canal on the greater curvature side in the region of the division normally seen between duodenum and stomach. The second is located on the greater curvature side proximal to the first. The ends of these two muscles terminate at the lesser curvature in a muscle called the muscle knot. The muscles are placed like a "V", with the apex at the muscle knot. As these muscles contract, the fluoroscopic appearance of the prepyloric region changes from a pseudodiverticulum to a gradually elongated and narrowed segment merging with the pyloric canal. The mucosal folds are oblique during incomplete contractions and longitudinal during complete contractions. The anatomical basis for this observation was established by Torgersen (Acta radiol. Supp. 45, 1942).

Twelve roentgenograms; 5 diagrams.

C. A. REID, M.D.
St. Vincent's Hospital, N. Y.

Contribution to the Radiology of the Postoperative Stomach. P. Cojan. J. de radiol. **38:** 1062–1068, November-December 1957. (In French) (Chaumont, France)

A roentgen examination to be carried out in the stomach after surgery is outlined, including views of the cardia in the upright position, a series over the stoma with and without compression and with the use of double contrast, roentgenograms with the pouch full of barium liquid, oblique views, and finally roentgenograms showing the amount of reflux into the loops. According to the author, this extensive examination is necessary for the complete study of the stomach following surgery.

The dumping syndrome is ascribed to various causes but, regardless of the absolute mechanism, it seems apparent that sudden filling of the distal loop of the anastomosis is the principal factor. In the author's opinion the sudden insufflation of the gastric pouch probably produces symptoms more often.

The syndrome of the afferent or proximal loop is encountered when this loop is quite large and the site of stasis. Such stasis indicates that the pancreatic and biliary secretions are probably utilized poorly and these facts in turn lead to digestive and metabolic troubles.

Dilatation of the gastric pouch may be caused by stenosis around the stoma, ulcers of the distal loop, and occasionally by changes produced by surgery. Reflux through the cardia, malposition of the gastric fundus, or hiatal hernia may be present. Gastrojejunal evagination, recurrent ulcer or tumor, and gastrocolic fistula are also demonstrable with careful postoperative examination.

Fifteen roentgenograms.

CHARLES M. NICE, JR., M.D.
Tulane University, New Orleans, La.

Pharmacoradiology of the Stomach and Duodenum. L. Arrieta Sánchez. Radiología **8:** 19–20, December 1957. (In Spanish) (Hospital Santo Tomás, Panama City, Panama)

This article reviews very briefly the history and present day uses of the various pharmaceuticals associated with the practice of radiology—barium, the iodides, Prostigmin, codein, bicarbonate of soda, morphine, etc.

The use of insulin in connection with radiographic examination of the upper gastrointestinal tract is discussed at greater length. Intravenous administration of 0.1 to 0.2 units of regular insulin per kilo of body weight, five to ten minutes prior to fluoroscopy, produces a pronounced gastric hyperperistalsis. This helps to rule out the stiffening which often accompanies disease of the gastric wall. In addition, the duodenal bulb dilates more than usual, remains full longer, and is more easily studied than when conventional methods are used. No cases of hypoglycemia

have been encountered with the method; but the author cautions that sugar should be kept on hand, and smaller amounts of insulin should be used in debilitated or aged patients. DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Intestinal Obstruction of Congenital Origin. A Study of Diagnosis and Management in One Hundred Sixty-Three Cases. H. William Clatworthy, Jr., and James R. Lloyd. Arch. Surg. **75:** 880–890, December 1957. (H. W. C., Jr., 695 Bryden Rd., Columbus, Ohio)

Fifteen per cent of developmental malformations involve the gastrointestinal tract, and the majority of these lesions produce some form of intestinal obstruction. If this is complete, it may cause death in the neonatal period; if incomplete, it can lead to prolonged disability. In a series of 163 consecutive cases reviewed by the authors, there were 56 deaths. The major contributing factor in 22 of these fatalities was delayed or inaccurate diagnosis. The authors emphasize the problems of early diagnosis in this paper.

Intestinal obstruction of congenital origin may be due to the following causes: (1) atresia or stenosis (intrinsic obstruction), (2) neuromuscular defects (primary intestinal aganglionosis), (3) anomalies of rotation and fixation, (4) meconium plugs and meconium ileus, (5) extrinsic lesions (annular pancreas, duplication, neoplasm), and (6) meconium peritonitis. The four cardinal manifestations are abdominal distention, bilious vomiting, abnormality of meconium evacuation, and maternal polyhydramnios.

The radiographic examination is the most accurate means of evaluating intestinal obstruction in the infant. Extreme dilatation and hypertrophy of the bowel will develop proximal to the site of the obstruction, while the distal bowel will remain small and thin-walled. Necrosis and perforation may develop and result in meconium peritonitis, and calcification may appear throughout the peritoneal cavity, having occurred during intra-uterine life.

Recumbent and erect roentgenograms should be made on all infants suspected of having intestinal obstruction. Careful study of the gas shadows and fluid levels will frequently be diagnostic. A barium-saline enema will at times be needed to differentiate large and small bowel obstructions.

Normally the stomach fills with the first breath. The duodenum will contain air in a few minutes, and the cecum in three to eight hours. With high intestinal obstruction, as with atresia of the duodenum, a double bubble or single huge "U"-shaped gas bubble may be seen. In patients with meconium ileus the intestinal loops will vary in size and foamy meconium masses may be present in the lumen.

The authors discuss the causes of congenital intestinal obstruction of the various types, along with specific surgical measures. DEAN W. GEHEBER, M.D.
Baton Rouge, La.

Duodenal Obstruction Due to Compression by Superior Mesenteric Root. William T. Tyson, Jr., and James M. Keegan. J.A.M.A. **165:** 1665–1668, Nov. 30, 1957. (J. M. K., 621 Fairchild St., San Antonio, Texas)

The authors report 4 cases of obstruction of the duodenum attributed to compression by the superior mesenteric root structures. Two patients were operated upon; in the other 2, free passage of barium through the duodenum into the jejunum was demonstrated fluoroscopically in the prone position.

The condition should be suspected in asthenic patients with vomiting. When the patient is placed in the supine position, a positive diagnosis can be made. There is a characteristic finding of a markedly dilated duodenum with a normal mucosa which is obstructed sharply just over the spine at the origin of the superior mesenteric structures. The patient is then placed in a prone position, and the area is watched to determine whether this will relieve the obstruction. This is an important test of the severity of the syndrome.

Medical measures are directed toward the deposition of fat in the body generally and particularly in the mesentery. If conservative measures fail to relieve the vomiting or if frequent exacerbations occur, surgical intervention is indicated. Duodenojejunostomy is the procedure of choice.

Five roentgenograms. B. JAY HILL, M.D.
University of Michigan

Herpes Zoster with Ileus Simulating Intestinal Obstruction. Steven J. Figiel and Leo S. Figiel. Am. J. Med. **23:** 999–1002, December 1957. (Grace Hospital, Detroit 1, Mich.)

A 65-year-old woman with known herpes zoster exhibited signs and symptoms suggesting intestinal obstruction. The findings on a survey film of the abdomen were consistent with an obstructive process of the left colon. A barium enema examination disclosed a long, smoothly constrictive area in the midsigmoid, partially impeding the passage of the barium. On the basis of roentgen interpretation of the changes in the sigmoid as representing an inflammatory and/or spastic condition, surgery was deferred and conservative treatment was instituted. The pathologic changes in the sigmoid disappeared slowly, the bowel finally assuming a normal appearance as demonstrated by progress enema studies. There was concomitant improvement in the clinical condition.

No other reported case of herpes zoster in which barium enema studies were performed revealed any abnormality of the sigmoid. The authors believe that in their patient the pathologic changes may have been due to direct involvement of the sigmoid by the herpes virus, since these changes cannot be satisfactorily accounted for on the basis of reflex segmental spasm.

The possibility of intestinal involvement in herpes zoster should be kept in mind in order to avoid undesirable and unnecessary surgical procedures.

Five roentgenograms.

Hirschsprung's Disease: The Roentgen Diagnosis in Infants. William A. Evans and Robert Willis. Am. J. Roentgenol. **78:** 1024–1048, December 1957. (R. W., Harper Hospital, Detroit 1, Mich.)

Hirschsprung's disease is generally accepted as being due to an absence of ganglion cells of the myenteric plexus in a segment of bowel, and removal of the aganglionic segment is the accepted method of treatment. The diagnostic criteria for roentgen diagnosis, however, are less well established, particularly for the newborn and the young infant. The authors report 24 new cases and summarize their experience in a total of 51 cases encountered at the Children's Hospital of Michigan during recent years.

The roentgen diagnosis of Hirschsprung's disease de-

pends on the recognition of the pathologic physiology resulting from a microscopic anatomic lesion in the bowel which causes bowel obstruction. The manifestations vary markedly in time of onset and in severity in different patients. Rectal biopsy in problem cases and special physiologic aids are a most important and useful contribution to diagnosis. The disparity in caliber between the ganglionic and aganglionic segments has formed the basis for the roentgen diagnosis of this disease as described by many observers. Not all newborn infants, however, show this disparity in caliber and it may not be recognizable or may be present to only slight degree in many young patients.

The primary manifestation of Hirschsprung's disease is a failure of the colon to empty its content and this can be recognized in the early postnatal period by the poor evacuation of the barium enema in contrast to the forceful, rapid evacuation in normal infants. The value of observing infants twenty-four to forty-eight hours or longer following administration of the enema is emphasized. Stasis occurs in both the ganglionic and aganglionic segments but is more marked in the ganglionic segment.

The authors find abnormal stasis in the bowel in young infants an early, dependable and fairly specific sign. Dilatation and hypertrophy of the bowel proximal to the lesion often occur later and are dependent more on the duration and less on the severity of the obstruction. The differential diagnosis is discussed, with consideration of the following lesions or diseases: atresia, stenosis, rectal web, stricture, meconium ileus, meconium plug, and ileal atresia.

The case reports are presented in a brief but pertinent fashion and the roentgenograms are excellent.

Forty-two roentgenograms.

NORMAN L. ARNETT, M.D.
Upland, Calif.

Changes in the Colon Following Resection and End-to-End Anastomosis. Sten Cronqvist. Acta radiol. **48**: 425–433, December 1957. (Roentgendiagnostic Department, University Hospital of Lund, Sweden)

Roentgenographic studies were made in 68 patients who had undergone resection of the colon with end-to-end anastomosis for diverticulitis or carcinoma. The patients were examined from less than a month up to twelve months after surgery. The more proximal the anastomosis, the more difficult it was to demonstrate roentgenologically. The changes at the anastomotic site, presumably due to edema, were seen best in the first month and subsided rapidly.

The author concludes that the optimum time for performing the initial roentgen examination following resection of the colon is three months after the operation. No definite statement concerning recurrence can be made before this period. Subsequent increase in postoperative changes suggests recurrence.

Thirteen roentgenograms; 1 diagram.

C. A. REID, M.D.
St. Vincent's Hospital, N. Y.

The Roentgenographic Diagnosis of Geophagia (Dirt-Eating) in Children; A Report of Sixty Cases. Joseph E. Gardner and Fethi Teveoğlu. J. Pediat. **51**: 667–671, December 1957. (Driscoll Foundation Children's Hospital, Corpus Christi, Texas)

Sixty cases of geophagia in children are reported to call attention to the importance of roentgen studies in patients suspected of eating dirt. All of the children in the present series were under five years of age; all were proved dirt-eaters and had anemia, achlorhydria, and dirt in the feces. Fifty-three children were Latin Americans, 4 Anglo-Americans, and 3 Negroes; all came from low-income families.

Some patients had complaints unrelated to geophagia, and the diagnosis was made incidentally on x-ray examination. In others geophagia was suspected either from the history or anemia, and a roentgenogram was taken to confirm the diagnosis. An anteroposterior view of the abdomen was sufficient for demonstrating dirt in the colon. The ingestion of any medicine or administration of heavy metals such as barium of bismuth must, of course, be excluded. In a patient with a large amount of ingested material in the colon, a chest film will establish the diagnosis. The appearance of the dirt in the colon was fairly constant, varying only in respect to the amount present. The dirt seemed dense and amorphous and the size of the individual aggregations of opaque substance varied greatly. The density was approximately that of bone cortex. The colon usually contained large amounts of fecal material consistent with the usual history of constipation.

Patients admitted to the hospital showed no evidence of dirt in the colon after three to ten days; those treated at home showed dirt in the colon for several weeks, indicating that dirt-eating continued. There was a rapid improvement following treatment with a cobalt-iron mixture in all cases.

Five roentgenograms; 1 table.

Reasons for Nonvisualization in Oral and Intravenous Cholecystography. Lidio G. Mosca and Giovanni Scavino. Radiología **8**: 15–17, December 1957. (In Spanish) (Buenos Aires, Argentina)

A review of the various causes for nonvisualization of the gallbladder is here presented, along with comments about the various technics which are commonly employed to improve results in doubtful cases.

Proper patient preparation is stressed. With the oral method, to eliminate bowel shadows, cleansing enemas and also intramuscular injection of Pitressin are advised, the latter to be given half an hour prior to examination.

The author feels that, rather than arbitrarily giving double doses of Telepaque, the dose should be one tablet per each 10 kilos of body weight. A preliminary fatty meal is without value. Films should be large enough to cover the rather wide area in which the gallbladder may be located.

Nonvisualization may not necessarily indicate gallbladder disease. Loss of contrast medium through vomiting or diarrhea, or the presence of liver diseases, such as infectious hepatitis or cirrhosis with liver decompensation, may be responsible for nonvisualization. The principal causes originating within the gallbladder and cystic ducts are: stones lodged in the cystic duct, stones filling the fundus, loss of concentrating power from inflammation, sclerosis of the gallbladder neck or cystic duct, adhesions of the neck of the cystic duct, or mucosal thickening, which usually accompanies icterus. Causes within the common duct are similarly changes following inflammation or obstruction by stones. Occasionally abnormalities of motility of the biliary ducts or of tonus of the sphincter of Oddi may bring about nonvisualization, through premature emptying of the medium into the duodenum.

The intravenous method should be used in all cases of nonvisualization with oral Telepaque, since it permits good appraisal of the state of the common duct, and the gallbladder visualizes in a fair percentage of cases, even though the concentrating power may have been lost. If morphine is given to diminish the tonus of the common duct and to increase that of the sphincter, visualization is even better.

The various methods of examination should be regarded as complementary, each with separate indications, and the intravenous method should not be used to displace the oral. DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Biliary Enteric Fistula. Frank Glenn and Henry Mannix, Jr. Surg., Gynec. & Obst. **105:** 693–705, December 1957. (New York Hospital-Cornell Medical Center, New York, N. Y.)

Biliary enteric fistulas are with rare exceptions complications of long standing and far advanced biliary tract disease. The authors present their experience with 40 such cases from a total of 4,500 patients requiring biliary-tract surgery during a twenty-four-year period.

Of prime importance is the establishment of the correct diagnosis. In the authors' series only 8 of the cases were diagnosed preoperatively; 3 patients had passed a gallstone per rectum while 5 had conclusive or suggestive x-ray findings. Clinically, the diagnosis should be suggested by a long-standing history of gallbladder trouble. The duration of biliary tract symptoms varies widely. In the typical history there is an initial period of gallbladder trouble followed by a long asymptomatic interval. The recurrence of symptoms is gradual and insidious and may be accompanied by recurrent episodes of moderate jaundice. If there are, in addition, clinical signs of acute small bowel obstruction, biliary enteric fistula with impaction of a gallstone into the terminal ileum should be suspected.

Roentgenographically the diagnosis is indicated by the discovery of air in the biliary tree or by the presence of a gallstone in the ileum. Oral cholecystograms rarely result in any visualization of the gallbladder or ducts. Intravenous cholangiography coupled with tomography may demonstrate the fistula. It may also be demonstrated by reflux of barium from an upper gastrointestinal examination or from a barium enema.

Four roentgenograms; 12 drawings; 1 chart; 1 table. ROBERT JACOBS, M.D.
University of Pennsylvania

Splenic Venography and Intrasplenic Pressure Measurement in the Clinical Investigation of the Portal Venous System. M. D. Turner, Sheila Sherlock, and R. E. Steiner. Am. J. Med. **23:** 846–859, December 1957. (Postgraduate Medical School, University of London, London, England)

The technics of intrasplenic pressure measurement and splenic venography are briefly described. One hundred and twenty-six venographic examinations have been performed by the authors on 109 patients with few serious complications. Seventy-three patients were suffering from hepatic cirrhosis of the portal or postnecrotic type, 10 from biliary cirrhosis, and 12 from extrahepatic portal vein obstruction without cirrhosis. The remaining 14 patients had a variety of conditions. The main indications for the procedure were gastrointestinal hemorrhage, neuropsychiatric disturbances in patients with cirrhosis, splenomegaly, hepatomegaly and ascites of uncertain etiology, and suspected hepatic tumors.

Comparison of intrasplenic pressure with the venographic picture shows that portal hypertension may be present in the absence of a portal-systemic collateral circulation and that the development of large natural or artificial portal-systemic shunts may be followed by a fall in the intrasplenic pressure.

Venography is of particular value in determining the state of the portal vein in patients in whom portacaval anastomosis is being considered. Nonfilling of the portal vein may be due to occlusion, the presence of a large collateral circulation with deviation of the injected material, or to unsatisfactory technic. The significance of this finding and the interpretation of the venogram are discussed.

This series confirms the previous experience that venography is superior to a barium-meal examination for demonstrating an esophageal collateral circulation. A barium swallow shows only the submucosal vessels, whereas venography may reveal the paraesophageal veins as well.

Most patients who have suffered hemorrhage from esophageal varices have portal hypertension, but a few with large varices have a normal portal pressure, suggesting that other factors may be important in the production of hemorrhage and that shunts should be large enough to carry the entire portal blood and allow collapse of these vessels.

Thirteen figures, including 7 roentgenograms; 2 tables.

RETROPERITONEAL TUMORS

Primary Retroperitoneal Tumors. Castor T. Surla, Elias E. Pantangco, and Juvenal C. Trinidad. J. Philippine M. A. **33:** 783–796, November 1957. (C. T. S., University of Santo Tomás Faculty of Medicine and Surgery, Manila, P. I.)

During the ten-year-period from 1947 to 1957, 12 cases of primary retroperitoneal tumor in which a definite histopathological diagnosis was made were operated on at the U. S. T. Charity Hospital, Manila. Eight tumors were malignant (3 malignant lymphoma, 2 neurogenic sarcoma, 1 lipomyxosarcoma, 1 fibrosarcoma, 1 undifferentiated sarcoma) and 4 benign (2 cysts of mesocolic origin, 1 neurofibroma, 1 neurilemmoma). The youngest patient was nine months of age and the oldest sixty-three years.

A correct preoperative diagnosis of retroperitoneal tumor was made in 7 of the 12 cases. The most valuable diagnostic aids were gastrointestinal and/or barium-enema studies and pyelography either retrograde or excretory. Gastrointestinal examination, carried out in 4 cases, showed displacement of the stomach and duodenum with extrinsic compression in 3. In 1 case there was displacement of the small intestine and ascending colon, with no evidence of intrinsic interluminary pathology. Pyelography was performed in 5 cases; in all a normal kidney pattern was demonstrable on the same side as the tumor. Displacement of the ureter and/or kidney was revealed in 3 cases. Presacral pneumography, done in 1 case, disclosed no abnormal findings.

Complete excision of the tumor was accomplished in 8 of the 12 cases in the present series. In 4 cases operation was limited to biopsy. There was 1 immediate

postoperative death. One woman was operated on twice for a retroperitoneal tumor, diagnosed histologically at first as neurofibroma and later as an undifferentiated sarcoma of embryonal origin. The patient died two years after the first operation. No long range follow-up has been made of the remaining cases.

Three cases of unusual interest are reported, including the one of recurring retroperitoneal tumor mentioned above.

Four roentgenograms; 5 photographs; 2 photomicrographs.

THE SPLEEN

Traumatic Rupture of the Spleen Diagnosed by Abdominal Aortography. Report of a Case. Hans-Gösta Norell. Acta radiol. **48:** 449–452, December 1957. (Roentgen Diagnostic Department, II, Södersjukhuset, Stockholm, Sweden)

Traumatic rupture of the spleen is of three types: (1) extensive rupture with immediate massive hemorrhage; (2) small lacerations with dribbling of blood; (3) intracapsular damage with delayed bleeding. Clinical diagnosis may be difficult, particularly in the second and third groups, in which symptoms are less alarming. In every case of splenic rupture, early diagnosis and surgical intervention are essential for the patient's chance of survival.

The variable findings as seen on survey films of the abdomen are briefly reviewed by the author, who states that positive findings are relatively few and inconstant and are not infrequently lacking altogether.

A case report is presented, with abdominal films demonstrating a soft-tissue density in the left hypochrondrium and loss of splenic outline. Percutaneous transfemoral abdominal aortography was performed nineteen days after injury. The branches of the splenic artery were seen to be separated and displaced in an arch, surrounding an expansile process corresponding to the lateral part of the spleen. In view of the x-ray findings and the nature of the injury, rupture of the spleen with a large lateral hematoma was regarded as probable. This diagnosis was confirmed at surgery, when rupture of the capsule was found laterally, with an encapsulated hematoma covered by omentum.

Two roentgenograms.

CHARLES M. GREENWALD, M.D.
Iowa City, Iowa

THE DIAPHRAGM

Traumatic Rupture of the Diaphragm. Clinical Manifestations and Surgical Treatment. Gerard Desforges, John W. Strieder, Joseph P. Lynch, and Irving M. Madoff. J. Thoracic Surg. **34:** 779–797, December 1957. (G. D., Tufts University Medical School, Boston, Mass.)

Sixteen cases of rupture of the diaphragm secondary to severe impact thoracic or abdominal trauma are presented. Automobile accidents, the most common cause, are usually accompanied by other serious injuries, which may obscure the clinical features of the ruptured diaphragm. It is important to diagnose and treat the condition at the time of the original hospitalization, to obviate the possibility of a later emergency operation for intestinal obstruction and to insure the patient maximum insurance benefits.

The left side of the diaphragm was ruptured in all but one of the cases. Of the 12 patients seen two weeks or less after injury, 11 had dyspnea while 1 was asymptomatic. Of the 4 treated from three months to twenty-six years after injury, one was asymptomatic and 3 had chronic gastrointestinal symptoms or those of acute obstruction.

The history plus serial plain roentgenograms led to the diagnosis in 13 of the cases. The others were diagnosed with films made after passage of a Levin tube into the stomach or with barium in the stomach or colon. Roentgen examination is the single most valuable tool in diagnosis of diaphragmatic rupture. With a history of trauma, a postero-anterior chest film, preferably upright, showing obliteration of the costophrenic angle, deformity of the diaphragmatic contour, abnormal density at the left lung base, or a collection of air below the left lung suggests the diagnosis.

Four patients in whom the stomach was herniated into the thorax had multiple thoracenteses for "pneumothorax." In doubtful cases a tube or barium in the stomach or colon may demonstrate a herniation. Occasionally, however, barium will not pass into the intrathoracic portion of the stomach due to obstruction at the site of tear secondary to torsion of the stomach. In acute cases of extensive diaphragmatic disruption, dyspnea, cyanosis, shock, and mediastinal shift with compression of the ipsilateral lung may be present.

Surgery is deferred until an early elective period unless the symptoms of displaced viscera indicate that the patient's life is in jeopardy. In the meantime gastric decompression may ameliorate the symptoms considerably. The lacerations are usually paracardial or through the dome, occasionally at the lateral wall attachments of the diaphragm. Repair can be made *via* thoracotomy.

Twenty-three roentgenograms; 10 drawings; 4 tables.

GARTH R. DREWRY, M.D.
Oakland, Calif.

Right Diaphragmatic Eventration. E. de Arzúa Zulaica, P. Elías Martínez, and J. M. Yarza Iriarte. Rev. clín. españ. **67:** 105–110, Oct. 31, 1957. (In Spanish) (Bilbao, Spain)

Eventration of the diaphragm is an abnormal elevation of the structure without interruption of its continuity. The condition is less frequent on the right than on the left, although partial eventration is more common on the right.

Congenital eventration is evidently related to failure of the diaphragm to descend secondary to pulmonary aplasia. Acquired eventration may be of neurogenic or myogenic origin. Phrenic nerve lesions from lacerations, blunt trauma, surgery, bronchopulmonary cancer, or mediastinal compression may produce atrophic changes in the diaphragm. However, in order to produce eventration, there must also be an associated increase in abdominal pressure or a thoracic abnormality to cause traction or decreased pressure above the diaphragm.

The diaphragm, though complete and covered by pleura and peritoneum, is reduced to a thin membrane with few or no muscle fibers, and its movements are diminished or paradoxical. The colon may be interposed between the liver and the diaphragm. There may be torsion or volvulus of the stomach.

Usually there are no symptoms, but there may be cough, dyspnea, chest pain, abdominal fullness or pain,

vomiting, and dysphagia. Occasionally palpitations, tachycardia, pain of coronary type, or cyanosis may occur.

The diagnosis is exclusively radiologic. The diaphragm shows a regular curve without loss of continuity. There may be associated displacement or deformity of the subdiaphragmatic viscera. Pneumoperitoneum will give the diagnosis in doubtful cases.

Partial eventration is more difficult to diagnose. To be ruled out are lung tumor or abscess, atelectasis, pleurisy, cysts, and neoplasms of extrapulmonary tissues. Hernia of the liver through the foramen of Morgagni, coelomic cyst, pericardial diverticulosis, and lipoma of the cardiophrenic angle region are other differential diagnostic possibilities. Here, too, pneumoperitoneum may be of great value.

In adults the prognosis is good, although the thin diaphragm may be more easily ruptured than normal. In children, eventration of the right diaphragm predisposes to atelectasis, pneumonia, and to abdominal visceral volvulus. In the presence of dyspnea or cyanosis in children, surgical treatment is indicated.

A single case in which stomach volvulus was associated is reported.

Seven roentgenograms.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

THE MUSCULOSKELETAL SYSTEM

Sarcoma in Paget's Disease of Bone. Charles A. Porretta, David C. Dahlin, and Joseph M. Janes. J. Bone & Joint Surg. **39-A:** 1314–1329, December 1957. (C. A. P., 8156 Normile Ave., Detroit, Mich.)

The authors present a clinical and pathologic study of sarcoma in Paget's disease of bone based upon 16 cases of osteogenic sarcoma found among 1,753 examples of Paget's disease of bone seen at the Mayo Clinic. The English-language literature was reviewed, and a total of 128 cases are discussed and evaluated as a group. In the Mayo Clinic group the average age of patients in whom the two conditions coexisted was fifty-eight years with a range from thirty-two to seventy-two years. The sex ratio was 2 males to 1 female, which is the same as the proportion in the 128 collected cases of sarcoma in Paget's disease.

Pain, swelling, or both were present in every case of sarcoma in Paget's disease, and these were the most important clinical features in the diagnosis. Many patients were unaware of the presence of Paget's disease until sarcoma developed. Of the sarcomata in Paget's disease of the long bones, 18 per cent developed at the site of recent fractures, which may or may not have preceded the onset of the tumor.

All 10 of the tumors examined microscopically in this series were osteogenic sarcomata. In 5 of the 7 cases in which Paget's disease was also noted microscopically, very cellular areas were seen, which might be termed presarcomatous.

Roentgenographic interpretation was often difficult, especially in lesions involving the ilium. In 8 cases, the roentgenograms were interpreted as showing Paget's disease with sarcoma. Two cases, both of the ilium, were believed to show Paget's disease only. Three cases, 2 involving the ilium and 1 the medial condyle of the femur, were interpreted as Paget's disease with a cystic area or with a large area of fibrous replacement of bone. Three cases, 1 each in the ilium, distal portion of the humerus, and greater trochanter of the femur, were diagnosed as Paget's disease but with the caution that a malignant lesion could not be definitely excluded. Three of the sarcomata were osteoblastic as seen roentgenographically and the other 13 were osteolytic or predominantly so. Of prognostic interest is the fact that roentgenograms of the chest revealed that 5 of these 16 patients had evidence of pulmonary metastasis at the time when they were first seen. One of these also had metastatic lesions in the skull, and a sixth had roentgenographic evidence of metastasis in the femoral neck and ischial tuberosity.

The prognosis of sarcoma in Paget's disease is poor, a single five-year survival being found among 128 cases reported in the literature. Treatment has consisted in amputation or roentgen therapy. Delay in diagnosis and treatment is considered to be one of the factors in the poor outlook, and suggestions for improvement are made.

Seven roentgenograms; 5 photomicrographs; 2 photographs; 3 tables. THEODORE E. KEATS, M.D.
University of Missouri

Progressive Hereditary Diaphyseal Dysplasia. Kenneth F. Stegman and J. C. Peterson. Pediatrics **20:** 966–973, December 1957. (J. C. P., Milwaukee Children's Hospital, Milwaukee 3, Wisc.)

The diagnosis of Engelmann's disease, or progressive diaphyseal dysplasia, rests on the x-ray demonstration of thickening and sclerosis of the diaphyses of the long bones, including the clavicles, and sclerotic changes at the base of the skull. The diaphyseal involvement is usually but not always symmetrical and may show skip areas within a single bone. The metaphyses and epiphyses are normal or only secondarily involved by porosis.

The authors followed a 5-year-old white boy for over three and a half years after the discovery of the lesion at sixteen months. This case was unusual on two counts. The child had progressive exophthalmos as well as marked separation of the cranial sutures. In addition to the bony sclerosis typical of the disease, there appeared to be changes in the muscle as well. Bone biopsy showed thickened periosteum and replacement of normal cortex with dense trabeculae. The marrow cavity was poor in fat and hematopoietic centers. The muscle contained scattered areas of focal necrosis with interstitial fibrosis but with no evidence of a general inflammatory process. The skin and subcutaneous tissues did not share in the pathological process.

This rare disease may be asymptomatic or may be manifested by muscular weakness, easy fatigability, inability to gain weight, limb and back pain, and retarded sexual, but not bony, development. The muscular weakness, which seems to be the basis for the clinical appearance of the patient, may be explained on the basis of the histopathological findings in the muscle biopsy reported by the authors, but further confirmation would appear desirable.

Four roentgenograms; 2 photomicrographs; 2 photographs. SAUL SCHEFF, M.D.
Boston, Mass.

Psoriatic Arthritis. D. D. Stephen. Proc. Coll. Radiologists Australasia **1:** 80–82, December 1957. (School of Radiology, R. P. A. Hospital, Sydney, N. S. W., Australia)

A case history is presented to demonstrate arthritic

changes of the joints of the hand in psoriasis. Two main types of associated arthritis and psoriasis are recognized: (1) psoriasis with coincident rheumatoid arthritis and (2) specific psoriatic arthritis. The author's case is in the latter group.

Radiologically the changes are those of atrophic arthritis, primarily involving the terminal interphalangeal joints of the hands and feet, where there is articular and periarticular destruction without osteoporosis. This destruction may go on to result in a spindle or thorn type phalanx. Hypertrophic change may occur, with marked lysis. Bony ankylosis is rare. There is lesser involvement of the proximal phalanges and carpal bones.

Similar radiologic changes occur in gout, which must be differentiated on the clinical history. Lack of involvement of the carpal joints and absence of osteoporosis rule against rheumatoid arthritis.

One roentgenogram. GORDON L. BARTEK, M.D.
Grand Rapids, Mich.

Cineroentgenography of the Normal Cervical Spine. J. William Fielding. J. Bone & Joint Surg. **39-A:** 1280–1288, December 1957. (139 Depew St., Dumont, N. J.)

The author used cineroentgenography to study the normal movements of the cervical spine.

At the atlanto-occipital articulation the only motions permitted are flexion and extension. The skull and first cervical vertebra otherwise move as a unit. It appears that little flexion occurs (about 10°), while the range of extension is much greater (about 25°).

The atlanto-epistrophic articulation was studied in the open-mouth view. This joint is the most mobile region of the spine. Four very distinct motions occur here; rotation, flexion, extension, and vertical approximation. The last term refers to telescoping of the first cervical vertebra on the second, occurring in rotation.

The whole cervical spine appears to lengthen during flexion and to shorten during extension, probably due to a change in lordosis, since no actual lengthening or shortening occurs. Below the second cervical vertebra, flexion, extension, lateral flexion, and rotation occur between the individual elements.

The intervertebral disks are roughly rectangular in outline in neutral position. As the spine assumes a forward flexed position, the higher vertebra shifts anteriorly over the one below. At the same time, the disk space narrows anteriorly and widens posteriorly. In the act of extension, the situation is reversed. This sliding, with its associated disk deformation is fairly well maintained from the first cervical vertebra downward to the sixth. In the upper region, the total sliding motion is greatest. The oblique view is essential for satisfactory visualization of the articular facets. In all motions, disk deformation and facet gliding occur together.

The intervertebral foramina are best visualized in the oblique projection. In full flexion the foramina enlarge and in extension they diminish. However, adequate foramina are apparent even when the facets are fully imbricated.

In many instances greater flexion occurs at the level of the fifth cervical vertebra than at any other interspace below the second cervical vertebra, even in apparently normal individuals who have had no difficulties with the neck.

The vertebral artery is protected throughout its course by the transverse processes, except between the axis and atlas, where about 1.5 cm. of the artery lies outside of the canal, subject to the stress of the great rotatory motion between these upper two segments. In rotation, this important artery is pulled forward and backward by the action of the first cervical vertebra moving on the second.

Eighteen roentgenograms; 6 photographs; 3 diagrams. THEODORE E. KEATS, M.D.
University of Missouri

Oblique Roentgenographic Views of the Cervical Spine in Flexion and Extension. An Aid in the Diagnosis of Cervical Subluxations and Obscure Dislocations. Bedford F. Boylston. J. Bone & Joint Surg. **39-A:** 1302–1309, December 1957. (1803 Calumet St., Houston 2, Texas)

The author uses oblique roentgenographic views of the cervical spine in flexion and extension as an aid in the diagnosis of cervical subluxations and obscure dislocations.

The most satisfactory means of obtaining such views is to place the Bucky diaphragm in an upright position with the patient either standing or sitting. The head is rotated maximally to the right, the left side being against the Bucky diaphragm. The chin is then flexed toward the right shoulder, care being taken to keep the cervical spine in maximal rotation, and the head is extended, full rotation being maintained. The tube is set in the position for making a postero-anterior roentgenogram of the chest or a lateral roentgenogram of the skull but is centered over the cervical spine. The body is not rotated; both shoulders are held firmly against the Bucky diaphragm.

This technic aids in demonstrating obscure lesions of the cervical spine in the same manner that stress roentgenograms demonstrate tears of the collateral ligaments of the ankle and knee. These views will allow a more positive diagnosis of acute sprain of the cervical spine.

Four cases are presented with roentgenographic and operative findings: marked unilateral apophyseal joint subluxation; unilateral fracture-dislocation; unilateral fracture of the articular process; minimal unilateral apophyseal-joint subluxation.

It is suggested that the ligamentum flavum is important in the stability of the cervical spine. Obscure anatomical lesions of this area are best demonstrated at operation, with the patient awake and sitting on the regular operating table, the laminectomy head rest being used.

Twenty roentgenograms; 3 photographs.
THEODORE E. KEATS, M.D.
University of Missouri

The Cervical Spine in Longitudinal Extension. J. Henssge. Fortschr. a. d. Geb. d. Röntgenstrahlen **87:** 726–730, December 1957. (In German) (DRK-Anscharkrankenhaus, Kiel-Wik, Germany)

Traction has been applied for relieving compression of nerve roots and soft-tissue interposition in small articulations. To determine how much widening of small joint spaces could be achieved by this means, lateral views of the cervical spine were taken in the supine position, with a cross-table technic and horizontal roentgen beam. The first view was without traction, while for the second view gentle manual traction was applied following curare medication. Small joint spaces could be stretched to double width in 10 normal individuals.

Manual traction can influence the alignment of the small articulations, especially between C-5 and C-6, but has very little effect on the intervertebral disks. Overmanipulation can easily prove harmful, but, when cautiously applied, manual traction with the aid of induced muscle relaxation is frequently helpful in reducing subluxation of the facets.

Six roentgenograms; 1 table.

ERNEST KRAFT, M.D.
Northport, N. Y.

Growth of Separated Epiphyses and of Osseous Particles. M. Pöschl. Fortschr. a. d. Geb. d. Röntgenstrahlen **87:** 756–760, December 1957. (In German) (Chirurgische Universitätsklinik, Munich, Germany)

Avulsion of an epiphysis will be followed by complete healing when the center of ossification remains intact. More frequently, however, the following post-traumatic disturbances of growth may be observed: (1) premature ossification of the epiphyseal line, (2) premature appearance and accelerated growth of the center of ossification, (3) retarded growth either of the shaft or of the epiphysis, (4) excessive longitudinal growth, and (5) epiphyseal necrosis.

The author has followed 165 cases of epiphyseal separation, 55 of which showed disturbance of healing. In 15 out of 26 epiphyseal separations studied roentgenologically, pseudarthrosis developed: in 10 with considerable overgrowth of the epiphysis, in 3 with only slight growth, and in 2 without change in this respect.

The bones of the elbow (humerus and olecranon process of the ulna) are the most frequent sites of epiphyseal injuries. When pseudarthrosis develops, the separated epiphysis becomes smooth and assumes a regular contour. Knowledge of such transformation becomes important in medicolegal decisions, as recent and old epiphyseal separations have to be differentiated from persistent epiphyses and accessory bones.

Nine roentgenograms. ERNEST KRAFT, M.D.
Northport, N. Y.

Supernumerary Intrathoracic Rib; a Case Report. George E. Plum, Alvin B. Hayles, André J. Bruwer, and O. Theron Clagett. J. Thoracic Surg. **34:** 800–803, December 1957. (Mayo Clinic, Rochester, Minn.)

The fourth reported case of supernumerary intrathoracic rib, the second surgically removed, is presented. The patient, a 9-year-old girl, was asymptomatic, with an abnormal mass discovered on a chest survey film. History and physical examination were normal. Films of the thorax showed a shadow with a convex lateral border lying posteriorly in the right hemithorax with its upper end near the right lateral border of the 6th thoracic vertebral body, extending downward to the 9th intercostal space. Twelve pairs of normal ribs were present. Preoperative diagnoses included anomalous blood vessel, intrathoracic cyst, lipoma, and duplication of the esophagus. Exploratory thoracotomy showed a rib articulating with the 6th thoracic vertebra anterior to the normal rib, within the thorax but outside the parietal pleura. The difficulty in diagnosis was due in part to the pleural reflections about the rib, giving it a "soft" cyst-like appearance. All reported cases have been on the right side. Tomography might have helped in diagnosis by showing the bony structure of the mass.

Four roentgenograms; 1 photograph.

GARTH R. DREWRY, M.D.
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Arthrographic Studies of the Shoulder Joint. Graham A. Kernwein, Bertil Roseberg, and William R. Sneed, Jr. J. Bone & Joint Surg. **39-A:** 1267–1279, December 1957. (Rockford Memorial Hospital, Rockford, Ill.)

The authors use arthrography of the shoulder joint in cases where the diagnosis is doubtful. Arthrography of the shoulder is a simple, safe, easily interpreted clinical test which is unusually accurate and which provides information that would otherwise be unavailable without an exploratory operation.

This is the report of a study in which contrast-media arthrograms were made of 96 problem shoulders. The clinical and arthrographic findings were correlated with the pathological findings seen at operation in 54 of the cases. The results demonstrate that arthrography, when correlated with a pain-obliteration, abduction-strength test, is superior to any diagnostic method available at present.

The technic utilized is as follows: The tender region about the shoulder joint is anesthetized, and the comparative strength of abduction and the range of active and passive motion are determined. Anteroposterior roentgenograms with the shoulder in internal and external rotation are obtained. Following this, the patient is placed in the supine position on the roentgenographic table, and axial roentgenograms are made in order to visualize the intertubercular groove. The arm is supported so that it does not lie on the table but is in a neutral position at the patient's side. The skin just below and lateral to the coracoid process is anesthetized and a 3-inch No. 20 spinal needle is inserted into the joint. Twenty cubic centimeters of 35 per cent Diodrast solution and an equal amount of distilled water are thoroughly mixed and injected into the shoulder joint under roentgenographic control. The contrast medium dilates and fills the joint space. When either 40 c.c. of the fluid has been injected or a definite resistance has been encountered, the syringe is detached and 10 to 20 c.c. of filtered air is injected. The needle is then removed. Following careful manipulation of the shoulder joint, phototimed spot anteroposterior roentgenograms are made with the shoulder in internal and external rotation. Axial roentgenograms showing the intertubercular groove are also made. If the tendon sheath contains the biceps tendon, it will be visualized as a filling defect in the contrast medium.

The examination is relatively painless. In this series there were no complications. The Diodrast disappears completely from the joint in two to three hours.

Three main characteristic arthrographic appearances were found. The first, which has seven distinguishing features and is considered normal, is common to a variety of conditions, including those in which there is no proved primary shoulder disease. The second is indicative of rupture of the rotator-cuff mechanism and is characterized by an increase in the liquid capacity of the joint as well as by visualization of the subacromial bursa. The third, found only in the presence of organic scapulo-humeral fixation, is characterized by the inelastic, nondistensible capsule and by considerable reduction in the size of the joint space; the other characteristics of this picture are normal.

The arthrographic findings were correlated with the pathological condition present at the time of operation in 54 instances. Of the 35 patients in whom the diagnosis was complete rupture of the shoulder-cuff mechanism and upon whomoper ations were subsequently

performed, 33 had a demonstrable lesion. Eight of these had a coexisting complete dislocation of the tendon of the long head of the biceps, 2 had complete rupture of the biceps tendon, 4 had a calcified supraspinatus, and 3 had a history of recurrent dislocation of the shoulder joint with rupture of the capsule at the glenoidal labrum.

Eighteen roentgenograms; 6 photographs; 1 table.

THEODORE E. KEATS, M.D.
University of Mssouri

Treatment of Fractures of the Os Calcis. Morton H. Leonard. Arch. Surg. **75:** 990–997, December 1957. (520 Montana St., El Paso, Texas)

Roentgenograms of good quality are needed to determine the type of injury to the os calcis before the necessary course of treatment can be determined. The examination should include lateral views of the foot and ankle; an anteroposterior view of the foot; an anteroposterior view of the ankle; and an axial view of the calcaneus. For the axial view the central ray should pass tangentially through the subastragalar joint.

Mild fragmentation of the tuberosity of the os calcis without joint involvement can usually be treated by brief plaster immobilization. With considerable displacement of the tuberosity, manipulation or open reduction may be needed prior to immobilization.

Open reduction is considered to be the treatment of choice for most fractures with severe displacement and involvement of the subastragalar joint. The author has found modifications of Palmer's technic (J. Bone & Joint Surg. **30-A:** 2, 1948) desirable. A Kirschner wire is placed through the tuberosity of the os calcis and held in a sterile bow. The joint is inspected and, if depression is present, an elevator is inserted beneath the depressed area while traction is maintained on the Kirschner wire. A bone graft is placed in the defect produced by elevating the depressed fragment. Roentgenograms are made in the operating room to assure that good reduction has been attained. A long leg cast is applied and the pin is incorporated into the cast. After six weeks the cast is cut down to the short leg type and kept in position for another six weeks. Weight-bearing is not permitted until revascularization of the graft is complete; this usually requires twelve weeks. In most cases the patient can be returned to heavy work in four to six months.

DEAN W. GEHEBER, M.D.
Baton Rouge, La.

An Experimental Study of Overgrowth After Fractures. Nicholas R. Greville and Joseph M. Janes. Surg., Gynec. & Obst. **105:** 717–721, December 1957. (Mayo Clinic, Rochester, Minn.)

Variation in growth of the femur following fracture and fixation was studied in 25 puppies. These were divided into a control and four experimental groups. Following insertion of marking screws, the midshaft of the femur was fractured either transversely or obliquely and fixed by various methods with different types of displacement.

An increase in growth was found in the fractured femurs as compared to the normal contralateral femurs. This increase was believed to come entirely from the epiphysis and varied according to the type of fracture and displacement.

Twelve roentgenograms; 1 graph; 1 table.

DAVID J. RITCHIE, M.D.
University of Pennsylvania

GYNECOLOGY AND OBSTETRICS

Hysterosalpingography. S. J. Behrman and J. H. Poppy. Canad. M. A. J. **77:** 938–943, Nov. 15, 1957. (University of Michigan Medical School, Ann Arbor, Mich.)

The findings in 442 consecutive hysterosalpingographic examinations are reviewed. Forty-five patients were studied because of habitual abortion, 239 for primary infertility, and 116 for secondary infertility. The indications for examination in the remaining 42 cases were myomectomy, wedge resection, artificial insemination, and as a preliminary to salpingostomy. Definite contraindications to hysterosalpingography are pelvic inflammatory disease, the presence of an intrauterine pregnancy, and a purulent vaginal discharge. It is also unwise to carry out the procedure immediately after menstruation or a dilatation and curettage. Only two complications were encountered in the series, both of which were exacerbations of local pelvic inflammatory disease simulating peritonitis and/or acute appendicitis. The authors believe that the ideal water-soluble contrast medium has not yet been found and favor the use of Lipiodol.

The high incidence of bilateral tubal occlusion in this series was striking. The vast majority of the patients, however, were referred to the hospital and consequently tubal lesions were more likely to be found. Of the 38 patients with bilateral occlusion and primary infertility, 6 subsequently became pregnant, as did 7 of 36 patients with secondary infertility and 1 of the 3 with habitual abortion. The authors contend that some of the bilateral tubal "occlusions" represent errors in technic and believe it unwise to accept a single hysterogram or CO_2 insufflation as conclusive evidence of bilateral tubal blocking. There was also a high incidence of unilateral tubal blockage, often due to actual occlusion or previous surgical removal of a tube.

Uterine anomalies were discovered in 31 cases. As one would expect, the highest incidence of polyps, fibroids, and other mild abnormalities was found in the group with habitual abortion.

Whether hysterosalpingography was performed for primary infertility, secondary infertility, or habitual abortion, pregnancy ensued in approximately 28 per cent of the cases. Of the 90 pregnancies, 62 occurred within three months after hysterosalpingography and 18 in the month of the procedure. The vast majority of patients in this series were referred to the authors after previous investigation elsewhere and after a period of infertility averaging four and a half years. It seems, therefore, more than mere coincidence that pregnancy occurred so soon after hysterosalpingography. An evaluation of the results in terms of age and duration of infertility before treatment leads to the conclusion that in patients who had no difficulty in conceiving originally, but now conceived, there was an additional factor other than age. Possibly hysterosalpingography contributed to the pregnancy, or conception may have resulted from release of psychiatric tension by reassurance from examination or possibly merely passage of time.

Five roentgenograms; 1 chart; 6 tables.

The Value of the 'Halo Sign' in the Diagnosis of Intrauterine Foetal Death. Ulf Borell and Ingmar Fernström. Acta radiol. **48:** 401–409, December 1957. (Karolinska Sjukhuset, Stockholm, Sweden)

The authors attribute the "halo sign" to Deuel, who,

in 1947, stated that "whereas in the live fetus roentgenograms show the subcutaneous fat of the scalp as a translucent line directly in contact with the cranial vault, in the dead fetus a space can be seen between the fat and the bones" (Schweiz. med. Wchnschr. **77:** 1003, 1947. Abst. in Radiology **51:** 144, 1948). This space was believed to result from the shrinkage of the brain and subsequent falling in of the bones of the cranial vault. The separation of the translucent fat line from the skull produces a halo effect.

The study was based on 42 cases of intra-uterine fetal death, occurring between the seventh and tenth lunar months of pregnancy. The interval between death and roentgenographic examination varied between two hours and four weeks. Roentgenograms of 763 women between the seventh and tenth lunar months of pregnancy and 49 women in labor were also studied.

In the normal cases, the translucent line of the subcutaneous fat was often visible as early as the seventh lunar month. Just prior to labor it was visible in all patients. It was constantly observed to be close to the cranial bones except in the region of the nape of the neck and the chin.

The halo was seen in 14 of the 42 cases of intrauterine fetal death. It was not seen within forty-eight hours of fetal death but was present in about half the cases in which the fetus had been dead a week or more. It was demonstrable as early as the seventh month of pregnancy. Gas in the fetal blood vessels was seen in 35 per cent of the cases and deformity of the head diagnostic of fetal death was seen in 17 per cent. In 3 cases the halo was the only sign of fetal death.

The dome-shaped separation seen in caput succedaneum was easily differentiated from the halo effect by its shape and location. The authors also present illustrations to differentiate the halo from the subcutaneous fat line over the fontanelles and from the thin layer of fat immediately outside the uterine wall.

The authors feel that if demonstration of the halo had been the objective at the time of the examination, it would have been found more often. In 15 cases in which films of the fetal head were taken in two projections, the halo was visible in 9, whereas in the 27 cases in which only one projection was taken, the halo was visible in only 5. It is felt that even greater accuracy could be obtained in cone-down views of the fetal head when fetal death is suspected.

Eleven roentgenograms. HOWARD GOULD, M.D.
St. Vincent's Hospital, N. Y.

THE GENITOURINARY SYSTEM

Sterile Fluoroscopy: Preliminary Report of a New Technique for Localization of Renal Calculi. Arnold M. Baskin, B. Marvin Harvard, and Arnold H. Janzen. J. Urol. **78:** 821–826, December 1957. (Yale University School of Medicine, New Haven, Conn.)

A new method of sterile fluoroscopy is proposed by the authors as an aid in localizing renal calculi at operation. For this procedure they use a sterilized, high-contrast lead screen, measuring approximately 10 × 7.5 × 1.5 cm., with rounded edges to prevent tissue trauma. The x-ray source is a standard portable machine equipped with a telescopic cone extending from 19 to 35 inches and $2^1/_2$ inches in diameter. The machine is operated at 60 to 80 kvp and 1 to 2 ma. The tube-screen distance is approximately 30 inches.

The kidney is delivered out of the operative wound and placed between the screen on one side and the extended cone of the portable machine on the other. Fluoroscopy is then performed by a member of the operative team, who is properly dark-adapted.

The radiation hazards of this technic are discussed and dose measurements taken during an actual procedure are given. The conclusion reached is that the exposure is tolerable if certain rules are strictly adhered to. (1) An appropriate beam-limiting cone should be used. (2) The fluoroscopic screen must be in direct line with the beam, and the beam should never fall outside the limits of the screen. (3) An adequate lead-glass screen must be used. (4) Common sense must be used regarding time and kv-ma factors.

Three figures. WALLACE T. MILLER, M.D.
University of Pennsylvania

Papillary Calcification in Necrotizing Renal Papillitis. Lee B. Lusted, Howard L. Steinbach, and Eugene Klatte. Am. J. Roentgenol. **78:** 1049–1052, December 1957. (Clinical Center, National Institutes of Health, Bethesda, Md.)

Calcification of renal papillae is presented as a significant roentgen sign in the diagnosis of necrotizing renal papillitis. Nephrocalcinosis and calcium encrusted necrotic papillae have been previously described but the calcification has not been demonstrated on roentgenograms. The improved prognosis of the disease with antibiotic treatment lends importance to the roentgen demonstration of papillary calcification.

The author reports a case with illustrative diagrams, sketches, and roentgenograms. Laminagraphy is particularly helpful in demonstrating the calcium rims and ring shadows that surround the necrotic papillae. Frequently these calcific shadows are of such poor definition that routine radiography may be of little help.

Six figures, including 4 roentgenograms.
NORMAN L. ARNETT, M.D.
Upland, Calif.

The Diagnostic Approach to Hypertension Due to Unilateral Kidney Disease. Albert A. Brust and Eugene B. Ferris. Ann. Int. Med. **47:** 1049–1066, December 1957. (A. A. B., Kettering Laboratory, University of Cincinnati, Cincinnati 19, Ohio)

The authors' purpose in the study reported here was (1) to report a method of pharmacologic blood-pressure assay which may offer preoperative information as to the potential reversibility of certain forms of renal hypertension and (2) to re-evaluate certain of the diagnostic features of the hypertension seen in association with remediable lesions of the kidney.

Fourteen patients suffering from benign and malignant hypertension were examined. The accepted studies such as urinalysis, differential kidney function tests, intravenous and retrograde pyelography were performed. Aortography was done in a few cases and, in spite of the attendant hazards, provided delineation of vascular lesions which otherwise would have been missed. Ganglionic blocking agents were administered intravenously to all the patients studied, and the effect on blood pressure recorded. On this basis the patients were classified as suffering primarily from parenchymal (5 cases) or vascular lesions (9 cases). The vascular group showed pressor or nondepressor response to ganglionic blocking agents, while the parenchymal group showed depressor response.

Nephrectomy was performed in all the patients with parenchymal lesions, with no cures, and in 5 of those with vascular lesions, with 4 cures. These vascular cases, on pathologic studies of the removed kidney, were found to conform to the Goldblatt type of hypertension.

The results in the small series of cases reported here suggest that hypertension associated with primary vascular renal lesions, giving a pressor or nondepressor response to ganglionic blocking agents, is amenable to surgery. The accepted methods of examination, such as urinalysis, differential kidney function tests, and pyelography, are of no help in predicting potentially reversible hypertension.

Four roentgenograms; 2 charts; 2 tables.

J. S. ARAJ, M.D.
Toledo, Ohio

The Pelvi-ureteric Junction. C. L. Rolleston and E. R. Reay. Brit. J. Radiol. **30:** 617–625, December 1957. (Departments of Diagnostic Radiology and Urology, Christchurch Hospital, Christchurch, New Zealand)

Hydronephrosis due to abnormality of the pelviureteric junction has been observed for a considerable period of time but in the authors' experience the findings at surgery have been properly correlated with the radiographic appearance only recently, since an anterior extraperitoneal surgical approach has replaced the conventional posterior route. With the latter type of incision considerable distortion is encountered and the situation is not visualized *in situ*.

It is felt that the majority of the difficulties in this region are caused by congenital anomalies, either intrinsic stenosis of the ureter, which may vary from an annular constriction at the junction to one involving the upper ureter for several centimeters, or ureteric fixation. In the last group a varying length of the upper ureter is firmly bound to the lower border of the renal pelvis by a dense fascial sheet which is extensive and fairly well defined. This stretches from the lower pole of the kidney to the aorta and inferior vena cava, crossing the pelvis and ureteropelvic junction anteriorly. The authors believe that this is a persisting mesentery supporting an abnormal lower pole vessel which may or may not be patent.

It is felt that the aberrant vessel itself rarely acts as the primary obstructing factor, the dense fascial sheet or mesentery playing the chief role. This appears to exert its greatest influence when the patient is supine, because of the posterior drag of the kidney.

Intravenous pyelography is an essential preliminary investigation in hydronephrosis. Successful filling of the upper ureter, however, will be achieved only in cases of partial obstruction which allow sufficient drainage of contrast medium into this segment to outline it adequately. Views thus obtained are valuable if the pelvis is intrarenal in type, but if the pelvis is dilated, the actual junction is obscured. For this reason the authors prefer the more definitive method of retrograde pyelography to assess the nature of the obstruction. They describe their technic and stress the use of a small amount of contrast medium and maintenance of the prone position after the investigation to facilitate drainage. A horizontal lateral view with the patient supine has been found much more informative than a similar projection in the prone position, providing a more accurate and functional picture of the nature of the obstruction.

In those cases in which the hydronephrosis is the result of ureteric fixation without intrinsic stenosis, operative repair consists in removing the fascial band or mesentery, cutting any associated abnormal vessels, and freeing the adhesions between the ureter and pelvis.

Operative drawings, sketches, pathologic specimens, and good quality radiographs accompany this article and emphasize to good advantage the authors' opinions.

Twelve roentgenograms; 4 photographs; 4 drawings.

J. A. GUNN, M.D.
Grand Rapids, Mich.

Pyelo-Ureteritis Cystica. Myles McNulty. Brit. J. Radiol. **30:** 648–652, December 1957. (Department of Radiology, Manchester Royal Infirmary, Manchester, England)

The principal object of this paper is to describe and illustrate the radiological features of pyelitis and ureteritis cystica and to assess their value in arriving at a diagnosis. The author has collected from the literature 16 cases which were proved histologically or followed for a sufficient length of time and to these has added 3 more.

The cause of this cyst-like process in the renal pelvis, ureter, and bladder is usually chronic infection. At first epithelial granulations or lymph follicles in the tunica propria are found, being described respectively as ureteritis granulosa and follicularis. Later, solid buds of epithelium become isolated in the tunica propria and by metaplasia develop into secretory glands. Finally cysts result from a retention of secretions. All authorities agree that the cysts are the result rather than the cause of the urinary infection which almost always accompanies them.

The disease usually occurs in the older age group and is most common in women. There are no pathognomonic signs but, as might be expected, there is invariably a history of urinary infection and often of renal calculi. Hematuria occasionally occurs.

A retrograde pyelogram is the best method of demonstrating ureteritis cystica. The intravenous pyelogram usually does not reveal the condition, though it may show diminished function or other abnormalities, thus leading to further investigation. The important feature radiologically is the presence of constant small defects in the contrast-filled ureter or renal pelvis, most numerous in the upper parts. When the cysts are large and widely spaced, the ureter and pelvis have a smooth outline with punched-out defects in the lumen. This is the most common radiological finding. Smaller cysts, closely packed together, give the ureter a ragged outline, while the contrast medium in the lumen has an appearance almost like foam.

In the differential diagnosis of ureteritis cystica a number of conditions must be excluded. Air bubbles are freely mobile. Multiple papillomata tend to occur in the lower part of the ureter while cysts are most numerous in the upper half. The distinction from tuberculosis can often be very difficult, but tuberculous granulations are not so smooth as the cysts and tubercle bacilli are found in the urine.

Surgery is necessary only for complicating lesions such as calculus or loss of renal function.

Ten roentgenograms; 2 photographs; 1 table.

J. P. CHAMPION, M.D.
Grand Rapids, Mich.

The Size of the Bladder on Intravenous Urography and Retrograde Cystography; A Potential Source of Diagnostic Error in Children. Samuel H. Rothfeld and Bernard S. Epstein. J. Urol. **78:** 817–820, December 1957. (Long Island Jewish Hospital, New Hyde Park, N. Y.)

The authors have found that, in the course of routine intravenous pyelography and retrograde cystography in the child, the bladder is frequently reported as dilated, while further studies have failed to reveal any basis for distention. In an attempt to establish criteria for the normal bladder and its deviations in children, a number of patients were studied. Two cases representative of the series are reported.

Radiographically, the bladder in the cases studied appeared distended or large, but critical analysis of the cystometric curves indicated that they were normal. The cystograms showed a smooth periphery, a longitudinal axis greater than the transverse diameter, and a symmetrical outlet. In the abnormal bladder, on the other hand, there is irregularity of the periphery, evidence of trabeculation, and, at times, an asymmetric or globular outline.

One explanation for the radiographic appearance of the bladder is that it is partly an abdominal organ until the age of ten, when it settles into the pelvis. Before this time, there is a relative disproportion between the bony pelvis and the bladder, which makes the latter appear distended. The authors conclude, therefore, that the so-called distended bladder of a child is not in itself of pathologic significance.

Four roentgenograms; 2 graphs.

JOSEPH WINSTON, M.D.
University of Pennsylvania

The Urogenital Sinus: Its Demonstration and Significance. Albert J. Paquin, Jr., David H. Baker, Nathaniel Finby, and John A. Evans. J. Urol. **78:** 796–807, December 1957. (New York Hospital-Cornell Medical Center, New York, N. Y.)

The authors stress the use of cystoscopic and radiographic visualization of the urogenital sinus to aid in the determination of the proper sex of a patient in whom this is in doubt, and to help decide the surgical procedures necessary to make the urinary and genital structures compatible with the sex assigned.

The presence of a urogenital sinus is abnormal except in the indifferent stage of the embryo. While the authors have observed urogenital sinuses in male and female pseudohermaphrodites and true hermaphrodites, the presence of such a structure does not mean that sexual ambiguity is necessarily present, nor does the absence of a urogenital sinus exclude the possibility of hermaphroditism or its variants. While the appearance of the urogenital sinus is not diagnostic of the type of sexual ambiguity present, the authors note that in male pseudohermaphrodites the sinus is frequently continuous with the urethra, while in female pseudohermaphrodites it is frequently continuous with the vagina.

Two cases of female pseudohermaphroditism with adrenocortical hyperplasia and 1 without, 3 of male pseudohermaphroditism, and 1 of true hermaphroditism are presented. In all of these patients the urogenital sinus was present.

Eight roentgenograms with explanatory diagrams; 5 drawings.

S. DAVID ROCKOFF, M.D.
University of Pennsylvania

TECHNIC

The Variable Angle as a Measuring Device in Radiography Including Tomography. E. Calder. Acta radiol. **48:** 453–464, December 1957. (Radiological Department, Royal Infirmary, Glasgow, Scotland)

Experimental application of a "variable angle device" for the simultaneous measurement of the linear dimension of an object and its height above a given plane is detailed. The author's main departure from other methods in use is that the measurement is based on the graphical localization of the rays incident to a graduated arm set at any convenient angle to the horizontal, the object being parallel or at an angle to the plane of the film or to the measuring device.

The device, described in a preliminary paper (Calder, E. Brit. J. Radiol. **29:** 386, 1956), is made of plastic material with two adjustable arms. A rod opaque to roentgen rays serves both as a pivot at the apex of the angle and for reference to the radiographed scale of the graduated arm, on which large and small lead pellets are mounted alternately at 5-mm. intervals for a distance of 65 cm.

The overall error for any linear dimension and focus-film distance rarely exceeds ±0.5 mm., with an outside limit of ±0.75 mm. The use of the angle device for tomographic work in the localization of the plane of section, estimation of the thickness of the tomographic layer, and verification of the depth scale of the tomographic outfit, is described.

Twelve figures.

CHARLES M. GREENWALD, M.D.
Iowa City, Iowa

Diagnostic Retroperitoneal Emphysema. Honorato Carvallo V. Radiología **8:** 11–13, December 1957. (In Spanish) (Hospital Civil San Vicente de Paul, Cuenca, Ecuador)

For performing retroperitoneal air insufflation, the author uses an artificial pneumothorax apparatus, and gives 100 c.c. of oxygen per minute through the usual injection site in the sacrococcygeal region. A total of 700 to 900 c.c. is usually given. More than this amount is not used since it may produce pneumomediastinum or cervical emphysema. Oxygen is preferred over air because it is more rapidly absorbed. A wait of one or two hours may at times be needed for adequate infiltration of the oxygen through the tissues. Discomfort to the patient is minimal.

A combination of this method with contrast urography produces striking urinary tract studies and has been found useful in cases of hydronephrosis, renal ptosis, postnephrectomy compensatory hypertrophy of the kidney, renal tumors and cysts, and renal tuberculosis. In addition, it has been useful for study of suprarenal and other retroperitoneal tumors, for outlining the gallbladder when contrast substances produce no visualization, for detail study of the bony pelvis and spine, and for cysts and tumors of the upper surface of the liver.

Three roentgenograms.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Glomerulotubular Nephrosis Correlated with Hepatic Lesions. IV. An Agonal-Phase Histoangiographic Technique for Serial-Time Hepatic and Renal Angiohistologic Studies and Its Application in Mercuric Chloride Poisoning. C. Neville Crowson and John B. King. Arch. Path. **64:** 607–613, December 1957. (C.

N. C., Deer Lodge Hospital, St. James (Winnipeg), Manitoba, Canada)

A microangiographic technic has been devised which combines serial-time histologic studies with serial-time blood-replacement arteriography instituted during the agonal phase in the rat. It can be adapted both to direct photography on clear unstained tissues and to radiography on sections or whole organs. It afforded good visualization of the arterial tree down to the level of the arterioles.

Application of agonal-phase angiography to studies of the renal and hepatic vascular alterations in mercuric chloride poisoning is described. The results compare favorably with those from *in vivo* fluorescent angiography.

Four radioarteriographs; 8 photoarteriographs; 2 photomicrographs; 1 photograph.

MISCELLANEOUS

The Roentgenographic Findings Associated with Neuroblastoma. Charlotte F. Hansman and Bertram R. Girdany. J. Pediat. **51:** 621–633, December 1957. (Children's Hospital, Pittsburgh 13, Penna.)

The findings in 30 histologically confirmed cases of neuroblastoma or ganglioneuroblastoma are presented. Sixteen patients were boys and 14 girls. Ages ranged from one month to ten years, with 15 children in the one-to-four-year age group. Roentgenograms of the abdomen, urinary tract, and skeleton were obtained in all cases.

An abdominal mass was palpable in 24 children and demonstrable roentgenographically in 26. Fourteen of the masses originated in an adrenal gland; a definite site of origin could not be ascertained for the other 12. Shadows of calcium density were seen in the region of an adrenal in 5 roentgenograms, and an enlarged liver shadow in 5 others. Dilatation and blunting of the renal calyces indicated obstruction to drainage of the upper urinary tract by the mass in 1 child. In another, a large kidney shadow with attenuation of the pelvocalcyceal system suggested renal infiltration. In 2 patients there was evidence of ascites and associated generalized edema of the lower extremities. Two children had mediastinal masses and 3 had extradural tumors.

Bony or soft-tissue changes of metastatic neuroblastoma were seen in the roentgenograms of 11 children. In 3 the bones alone were affected and in 2 the changes were limited to the lungs and meninges. Six children had combined bony and soft-tissue metastases. Pulmonary metastases were present in 4 of these children. Seven children had metastatic lesions in the skull. Four of these also had roentgen evidence of increased intracranial pressure, and in 1 instance this was the only abnormality demonstrable in the skull film. Widened sutures and destruction of the bones of the cranial vault are considered pathognomonic of metastatic neuroblastoma. Eight children had lesions in the femurs and 4 showed changes in the bony pelvis. In 1 case femoral involvement was unilateral. Bones of the lower legs and upper extremities were invaded less frequently. In all cases of long-bone involvement both metaphyses and diaphyses were affected.

The differential diagnosis of neuroblastoma is discussed. The radiographic picture associated with the primary tumor is not characteristic. It may be impossible to distinguish between Wilms' tumor and neuroblastoma preoperatively or even at surgery. When the tumor has metastasized and leg or back pain brings the patient to the physician, leukemia, scurvy, and malignant bone tumors must be ruled out. Tuberculosis of the spine, osteomyelitis, acute rheumatic fever, and poliomyelitis often must be taken into consideration. The skeletal changes of leukemia and metastatic neuroblastoma are radiographically indistinguishable. Bone marrow aspiration is useful in establishing a diagnosis. Roentgen changes in the long bones may dictate an optimal site for bone marrow study. Four of 11 children in the present series having bone marrow smears positive for tumor cells did not show abnormal roentgen changes in the bones.

Twenty-two roentgenograms; 5 tables.

Roentgenologic Demonstration of Calcification and Ossification in the Periarticular Soft Tissues Following Burns. J. Kolář and R. Vrabec. Fortschr. a. d. Geb. d. Röntgenstrahlen **87:** 761–765, December 1957. (In German) (Karls-Universität, Prague, Czechoslovakia)

Soft tissue calcifications are either metabolic, in association with elevated blood calcium and phosphorus, or dystrophic, due to local disturbances. The latter can be degenerative, inflammatory, necrotic, trophic, or traumatic. Post-traumatic calcifications are most frequently seen close to the medial femoral epicondyle and in the region of the elbow following a fracture or dislocation.

Seven hundred and fifty patients with burns were followed periodically for development of para-articular changes, but soft-tissue calcifications could be found in only 25 cases (3.3 per cent), especially in the more severe burns. Areas of the knee, ankle, and elbow were most frequently involved, but calcifications could also be observed in the region of the shoulders and hips. The following types were seen: (1) circumscribed cloudy, patchy, or streaky calcifications, (2) periosteal apposition of varying length and height, and (3) extensive articular calcification and ossification with ultimate bridging of the joint. There was no age preference. Calcifications usually developed during the first six months following the injury, starting as early as the second, and became stationary during the following six months.

The changes cannot be explained entirely on the basis of the burns, because they are usually confined to a single area and may fail to develop elsewhere in patients with multiple burns. Pathogenetically, one has to consider secondary infection, which is frequently associated with severe burns. The offending microorganisms are *Staphylococcus pyogenes aureus haemolyticus* and especially *Streptococcus pyogenes*.

Eight roentgenograms. ERNEST KRAFT, M.D.
Northport, N. Y.

Planning of Radiology on a National Basis. R. F. Sethna. Indian J. Radiol. **11:** 48–52, July 1957; 98–105, November 1957. (Grant Medical College, Bombay, India)

The author urges the early formation in India of a National Board of Radiology. The composition and functions of such a Board are outlined.

At the present time there are 44 medical colleges in India and 3 universities conferring diplomas in Medical Radiology. One important function of the Board should be to evolve schemes for improving and making more uniform undergraduate and postgraduate training

in radiology. The value of anatomico-radiological education in health during the preclinical period is emphasized, and a plan of teaching suggested.

The Board should also maintain a registry of qualified radiologists to be supplied to all medical colleges and hospitals in the country.

A plea is made for the separation of radiodiagnosis and radiotherapy.

Arguments are advanced for changing the age of retirement from fifty-five to sixty-five or seventy years and for the appointment of radiologists on a full time basis.

RADIOTHERAPY

The Effect of Preoperative Radiation on Subsequent Surgery in Carcinoma of the Larynx. William M. Trible. Ann. Otol., Rhin. & Laryng. **66:** 953–962, December 1957. (1150 Connecticut Ave., N. W., Washington, D. C.)

Treatment of carcinoma of the larynx is either by surgery or irradiation, and the methods are combined only in event of failure of that first attempted. Objections which have been offered to routine preoperative irradiation are: (1) it delays definitive surgical treatment; (2) postirradiation edema makes it difficult to identify residual disease, and frequent direct laryngoscopies and biopsies are required; (3) surgery is complicated by more bleeding, distortion of cleavage planes, and the difficulty of distinguishing between radiation and tumor changes at the operating table; (4) postoperative morbidity is increased, especially by wound complications; (5) any improvement in the salvage rate with combined treatment is doubtful.

The author reports a series of 14 patients who underwent surgery after radiotherapy. Approximately 7,000 r to the tumor was delivered through two portals in a period of from five to six weeks. The radiation evokes a classical inflammatory reaction in the tumor bed. The resultant fibrosis and endarteritis narrow or occlude the blood vessels and lymph channels, which may be an underlying factor in many of the wound complications. Marked persistent edema after irradiation therapy over the arytenoid may obscure both direct and indirect laryngoscopy, making identification of the state of the disease difficult.

Despite the edema, changes in vascularity, and other difficulties mentioned, the author believes that conventional irradiation therapy does not adversely affect the performance of a laryngectomy, with or without neck dissection, after an interval of six months. Wound healing is delayed, however, increasing the stay in the hospital, and plastic procedures are frequently required.

Since routine preoperative irradiation therapy may result in increased postoperative morbidity in addition to the discomfort of irradiation reaction in the six months between radiation and surgery, it can be justified only by a marked increase in salvage rate. The author's feeling is that irradiation has a place in the treatment of early lesions of the freely movable true cord, but that the borderline cases with questionable mobility, or questionable extension subglottically or into the ventricle, are better spared the "trial of radiotherapy."

DEAN W. GEHEBER, M.D.
Baton Rouge, La.

Some Factors Influencing Prognosis in Breast Cancer. Robert McWhirter. J. Fac. Radiologists **8:** 220–234, April 1957. (Royal Infirmary, Edinburgh, Scotland)

The prognosis in a patient with cancer of the breast is influenced by many factors. One of the most important of these is the *extent of the spread from the primary site.* This is usually denoted by a stage number. The value of staging would be enhanced if the same form of stage-grouping were in use in all centers throughout the world. Unfortunately this is not so, and there are sharp differences of opinion concerning which system is best. The author offers suggestions which may assist in resolving the problem: (1) Staging, while of value in indicating prognosis, is of still greater value in other spheres. The main purpose is to form categories of cases which may be compared with one another. (2) In many respects the lines of demarcation between categories are more important than the content of the categories. (3) The extent to which a tumor has spread cannot be determined with accuracy. (4) The staging must be based on clinical findings. (5) A certain range of spread must be accepted within each stage. There are three natural divisions of the extent of spread: (1) disease apparently localized, at a moderately early stage, and accordingly operable. This group may be further subdivided into those cases without palpable axillary nodes (Stage I) and those with palpable axillary nodes (Stage II); (2) disease localized but too advanced to be operable (Stage III); (3) disease with distant metastases, where no known method of treatment will cure the patient (Stage IV).

Size of the Primary: Large tumors are more frequently associated with axillary node involvement and with more distant metastases and, accordingly, a correlation might be expected between the size of the primary tumor and the survival rate. An analysis of operable cases shows that this is so. In the author's experience, patients with small tumors have a survival rate approximately twice as favorable as patients with large tumors.

Information concerning the *natural rate of growth of the breast tumor* is extremely difficult to obtain. Patients' statements concerning the duration of tumors are unreliable. Whatever the rate of growth, the preclinical period will always be longer than the clinical period. In seeking the cause of breast cancer, greater attention should be paid to factors at a much earlier period in the life-history of the patient, since breast cancers especially are slow growing. In the author's opinion, too much attention has been paid to the age-period during which cancer becomes clinically obvious. Factors operating in the premenopausal period may be of much greater importance than those acting at the time of the menopause. Mathematical calculations of the rate of tumor growth explain why patients with tumors of the order of 1 cm. in diameter are not always cured. Such tumors may have been present for many years and, in that interval, metastases to distant sites could have occurred at any time, long before the primary tumor was clinically recognizable. Rapid increase in the size of a tumor whose growth has hitherto been slow does not necessarily indicate that the cells are dividing more frequently.

Delay Before Treatment: It has been noted in patients

who delay for a year or more before having an operation that the survival rate may be equal to, or even better than in patients who have not delayed. This finding has led to the belief that, since it appears to be immaterial when an operation is performed, the operation is merely an incident in the course of the disease and does not alter its course. The finding is correct but the conclusion is wrong. In operable cases, if a patient has a tumor which is still operable after a year, the tumor is relatively benign and of slow growth, and hence has a good prognosis. Rapidly growing tumors will not remain operable after a year delay. The findings in the locally advanced category can be explained on the same basis. When, however, the survival rates of all cases, including those with distant metastases, are analyzed, it will be found that the survival rate falls as the delay increases. The rate falls because a relatively homogeneous group (in respect of extent of disease) is no longer being considered. In the overall figures the proportion of patients with distant metastases is much higher among those who delayed for a year or more.

Age and Survival Rate: It is commonly stated that the prognosis in breast cancer is better in elderly patients than in young patients. Evidence presented by the author shows that, with the exception of the very youngest patients, the survival rate tends to fall as the age of the patient increases. This is due to a number of factors. One of the most important is that as patients advance in years their general health becomes poorer and intercurrent disease more frequently coexists. Cardiovascular degeneration in particular often precludes any form of treatment or permits only palliative therapy.

Pregnancy and Lactation: The prognosis of patients in whom cancer develops in association with pregnancy or lactation is generally regarded as being extremely poor. The author is doubtful, however, if the influence of pregnancy is as great as has been maintained. Records show that often the patient was given the wrong advice and proper therapy was delayed. When pregnancy and lactation carcinomas are treated while still operable, the results can be almost as good as in cancers uncomplicated by pregnancy.

Male Breast Carcinoma: In spite of the fact that small tumors should be much more easily detectable in the male breast, delay in treatment is often considerable. This, coupled with the fact that the tumor tends to become fixed to the chest wall at an early stage, probably accounts for a poorer prognosis.

Site of Tumor in Breast: It is generally accepted that the prognosis of tumors in the inner half of the breast is poorer than for tumors in the outer half. In Edinburgh, to an increasing extent, attempts have been made to irradiate the lymph nodes in the internal mammary chain, in addition to nodes in the upper chain. In a series of 1,180 patients, the five-year survival of women with inner-half tumors was higher (58 per cent) than in those with outer-half tumors (52 per cent).

Histology: There is no doubt that the degree of differentiation or grade of the tumor does influence the prognosis. It is desirable that such analyses always be superimposed on the clinical staging and not be treated independently.

Treatment: The method of treatment employed also influences prognosis. The author notes that it is now widely recognized that in many patients where it is technically possible, the "radical" operation alone is an incomplete form of treatment. Furthermore, a large number of patients with breast cancer are quite unsuitable for radical mastectomy. Carefully planned radiotherapy must remain an important ancillary to surgery in the management of breast cancer.

Modification of factors which influence prognosis is discussed briefly.

Sixteen tables.

Results of Electrosurgical Radical Mastectomy with Routine Skin Graft and Postoperative X-Ray Therapy. A Review of 309 Cases. Dudley Jackson and Dudley Jackson, Jr. Cancer 11: 18–21, January-February 1958. (Nix Memorial Hospital, San Antonio, Texas).

This report is a statistical analysis of 293 breast cancer patients (from a total of 309) treated by a definite, predetermined method and adequately traced. To avoid the tendency to subcutaneous seeding along the course of the scar, the authors employed an extra wide Halsted type of elliptic incision so that skin grafting became an almost invariable part of the procedure. The incision and removal of the tumor along with a good margin of normal tissue are accomplished with the "Bovie," the Liebel-Flarsheim Company's diathermy knife. The actual axillary dissection is carried out by scalpel.

Every patient in this study was given routine postoperative, fractionated radiation through multiple portals covering the breast area, the axilla, and the supraclavicular areas. Intensive radiation was directed through multiple small portals to the internal mammary chain when the carcinoma was medial to the nipple.

Of the 293 patients, 221 (75.4 per cent) were alive and free of cancer after five years. The survivors included 140 patients out of an original 155 (94 per cent) with no axillary involvement at operation. The remaining five-year cures included 25 of 29 cases with one axillary node and 53 of 108 patients (49.1 per cent) with multiple positive nodes. Only 3 of the 293 (1.02 per cent) had local recurrence.

Ten years have elapsed since 136 "determinate" patients were treated by the above technic. Eighty-five of these (62.5 per cent) were alive at the end of that period. In this group 66 of 69 (95.6 per cent) had no axillary node disease; 19 of 67 (28.4 per cent) with axillary involvement lived ten or more years. Ten of the 67 with nodal involvement had a single positive node, and all of these survived for the ten-year period, but only 9 of the remaining 57 (15.8 per cent), with multiple node involvement, were still alive. There was a local recurrence in 8 (5.8 per cent) of the 136 ten-year cases.

The authors feel that the "more than satisfactory salvage rate achieved" should give rise to careful consideration of their technic.

One table.

SAUL SCHEFF, M.D.
Boston, Mass.

Treatment of Cancer of the Lung by Interstitial Implantation. Eugene E. Cliffton, Ulrich K. Henschke, and Henry H. Selby. Cancer 11: 9–17, January-February 1958. (Memorial Center, New York, N. Y.)

The authors report a series of 129 cases of primary bronchogenic carcinoma and 11 of metastatic disease or intrathoracic carcinoma arising in another viscus. All were treated with interstitial implantation of radon seeds at the time of thoracotomy, between 1941 and 1955. The discussion is limited to the 129 bronchogenic carcinoma cases, and particular attention is directed to the duration of symptoms prior to implanta-

tion; supplementary therapy, including external irradiation; thoracotomy findings; implant data; survival and subjective improvement after therapy. Tumor size was estimated from pre- and post-implantation films. The implant dose was calculated, whenever possible, on the basis of total millicuries of radon and the ratio of millicuries to implanted volume, the Paterson-Parker factors being used for volume and planar implants.

Doses as high as 10,000 to 25,000 r were tolerated without late complications of fibrosis and tissue necrosis. The only early complication was an esophagitis of varying severity that cleared in three to five weeks with symptomatic treatment. Local recurrence of tumor was rare and was seen only after implants that were technically unsatisfactory.

Of the 129 patients with bronchogenic carcinoma, 21 had resections in addition to implantation at the time of thoracotomy. Total pneumonectomy in 9 patients resulted in 4 operative deaths; and the average survival for the remaining 5 patients was 8.7 months. Limited resections, including lobectomies, yielded better results, with an operative mortality of only 25 per cent. The average survival was 17.4 months when the operative deaths were included and 22.6 months if they were excluded. One patient was alive and well eight years after implantation. For 108 patients with implants only at the time of thoracotomy the survival averaged 10.3 months.

Histopathological differentiation had some effect on survival. In 24 patients with anaplastic oat-cell cancer the average was 9.6 months; for 51 with squamous-cell cancer the average was 9.8 months. Six patients with adenocarcinoma survived an average of 11.5 months, while 27 with unclassified cancers lived 10.5 months. The longest duration of life after thoracotomy and implantation occurred in 5 cases of superior sulcus tumors, the average survival being 27.8 months.

Eleven roentgenograms. SAUL SCHEFF, M.D.
Boston, Mass.

The Pathogenesis and Management of Neurological Complications in Patients with Malignant Lymphomas and Leukemia. Henry M. Williams, Henry D. Diamond, and Lloyd F. Craver. Cancer **11**: 76–82, January-February 1958. (Memorial Center, New York, N. Y.)

The authors reviewed the records of 5,778 patients with lymphomas or leukemias admitted to the Memorial Center for Cancer (New York) from 1926 to 1956 and found neurological complications in 795.

Spinal cord compression occurred in 118 patients. Seventy-eight patients exhibited clinical evidence of active paravertebral disease at the level of cord compression, while in 19 paravertebral disease, though not observed clinically, was demonstrable radiologically. In 11 persons there was anatomical, radiographic, or clinical evidence of epidural lymphoma without other local disease. The dura apparently effectively barred further invasion except in 1 patient with reticulum-cell sarcoma. Neurological recovery was more frequent in patients with Hodgkin's disease and in those with less than complete paraplegia. Optimum therapy for cord involvement was a full course of nitrogen mustard (0.4 mg. per kg. body weight) followed by 2,000 to 4,000 r (in air) through portals extending about four spinal segments above and below the level of neurological involvement. In cases where compression fracture is wholly or partially causing the symptoms, laminectomy followed by radiation is indicated. In the absence of compression, however, laminectomy had little or no effect on the course of the symptoms except in multiple myeloma.

Cerebral symptoms appear to have been present in 36 cases. These were due to intracranial lymphoma in only 11 instances. Patients with leukemia were more likely to have symptomatic lesions. Eighty per cent of the patients obtained good relief following irradiation with more than 1,000 r (air). Nitrogen mustard alone, used in very few cases, seemed ineffective.

Local compression by tumor was responsible for the great majority of the 72 cases with cranial nerve signs and 130 with peripheral nerve involvement. About half the lesions cleared symptomatically with local irradiation. Herpes zoster, on the other hand, appeared to be initiated by tumor in the afferent portion of the reflex arc and was totally refractory to therapy. Pituitary destruction by tumor, with or without diabetes insipidus, and fungal, yeast, and other exotic central nervous infections were usually unresponsive to treatment. Intracranial hemorrhage appeared terminally in acute leukemia where marrow involvement produced marked thrombocytopenia.

Eleven tables. SAUL SCHEFF, M.D.
Boston, Mass.

The Treatment of Wilms's Tumor. Vincent P. Collins. Cancer **11**: 89–94, January-February 1958. (Baylor University College of Medicine, Houston, Texas)

Wilms' tumor is prenatal in origin, and has therefore been present months or years before treatment is started. Cure is possible if metastasis has not occurred and if all cells can be removed or destroyed by irradiation.

Each tumor has its own particular rate of growth, which probably is about the same after surgery as before. This growth rate sets a limit upon the length of time in which a recurrence should appear, if one is to develop. Therefore, it is possible to define a time limit for the period of risk of recurrence in any individual case. For example: in a patient with a tumor diagnosed at the age of twelve months, the tumor obviously could not have been growing for more than twenty-one (twelve plus nine) months. If it recurs after surgical removal, it should again reach a recognizable size in a maximum of twenty-one months. Accordingly, a patient living and well beyond the period of risk might be regarded as cured.

Using this method of analysis, the author reviews 340 cases; 73 patients survived the period of risk without recurrence, for a cure rate of 21.5 per cent. A previously reported series by Gross (Gross, R. E.: Surgery of Infancy and Childhood. Philadelphia, W. B. Saunders Co., 1953) gave a 47.3 per cent survival rate, which he ascribed to a policy of emergency surgery and immediate postoperative radiotherapy. Patient age and duration of follow-up were not specified.

Report of a high cure rate implies that in a series with a lower cure rate treatment methods have been inadequate. The author suggests that the discrepancy may be related to the fact that different base lines were used for measuring and recognizing treatment results. He suggests that the urgent necessity for immediate postoperative irradiation has a doubtful basis.

The author advocates preoperative irradiation for approximately 1,000 r tumor dose, sharply limited to the tumor mass, given in one week. Operation is then deferred for a week to allow the effect of treatment to become evident. The delay in resection is short relative to the total prior duration of the tumor, and the only new risk of dissemination is that of spillage of cancer cells at surgery. Postoperative irradiation is then delivered to the tumor bed, for about 2,500 r in four weeks. Proportionately less is given if preoperative irradiation has been carried out.

Four figures; 2 tables.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

The Time Factor in Radiotherapy of the Painful Shoulder. Federico García Capurro. Radiología **8:** 7–9, December 1957. (In Spanish) (Montevideo, Uruguay)

The author discusses the radiation treatment of painful affections about the shoulder of inflammatory origin, advocating smaller doses than are customarily employed and more patience in awaiting results. After long experience with both high- and low-dosage technics, he feels that as good results are obtained with the latter as with the former. This he explains as follows: We know from its action in treating malignant diseases that irradiation has an inhibitory effect upon cellular activity. Excessive doses are incompatible with normal cell function. To overcome inflammatory processes, the cellular processes of defense and repair need to be accelerated. Irradiation should be performed, therefore, so that overdosage is carefully avoided.

Using treatment factors of 200 kvp, 10 ma, 1 mm. Cu filtration, and 40 cm. treatment distance, the author gives doses of 50 to 75 r, repeated three or four times at two- or three-day intervals. A second series is given after four weeks if resolution of symptoms has been incomplete. During the waiting period the use of shortwave diathermy, infra-red heat, hot packs, or ultrasonic therapy is advised to help palliate the pain and to decrease the limitation of motion which may accompany the disease.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Measured Dose Distributions in Arc and Rotation Therapy: A Critical Comparison of Moving and Fixed Field Techniques. J. F. Fowler and F. T. Farmer. Brit. J. Radiol **30:** 653–659, December 1957. (Royal Victoria Infirmary, Newcastle upon Tyne, England)

An experimental set of water phantoms with transparent walls, shaped to pelvic and thoracic cross sections, was used in this study. Thimble chambers were inserted at various points to measure the radiation, making it possible to obtain a complete isodose line in the transverse plane. Comparison was then made between the integral dose, skin dose, and central dose with well planned multifield fixed-beam technics and those with arc or moving-field technics.

It was found that the integral dose from long-axis rotational therapy is greater than with well planned fixed fields, and that without very careful planning of the rotation, with the use of such devices as flattening filters and "overlap," the discrepancy between the doses would be even greater in favor of the fixed field approach.

Similar comparisons were made between 250 kv as opposed to supervoltage irradiation and, as would be expected, the clear superiority in dosage with supervoltage was apparent.

The authors conclude that there is little justification for the perpetuation of the saying: "Arc therapy is the poor man's supervoltage."

Six figures; 2 tables.

J. A. GUNN, M.D.
Grand Rapids, Mich.

A Substandard Condenser Dosemeter and Its Calibration Against Four National Free-Air Standard Chambers. R. Thoraeus. Acta radiol. **48:** 473–483, December 1957. (Institute of Radiophysics, King Gustaf V Jubilee Clinic, Karolinska Sjukhuset, Stockholm, Sweden)

The design and measuring properties of a substandard condenser dosemeter in use at the Institute of Radiophysics, Stockholm, are described. It includes a number of various separate ionization chamber units and a suitable number of interchangeable, additional capacitors. The ionization chamber units form the fundamental part of the condenser dosemeter. The function of an added capacitor is to reduce the sensitivity of the chamber unit to the level required by the actual conditions. By this design each chamber unit may be used separately and, with or without an added capacitor, calibrated against a free-air standard chamber.

This instrument has been in use for about ten years, during which period it has been calibrated against the national free-air standard chambers of Sweden, Great Britain, U. S. A., and Western Germany. Some test results and the calibration factors obtained are presented. The series of calibration factors agree within ± 1.5 per cent.

Three figures; 4 tables.

CHARLES M. GREENWALD, M.D.
Iowa City, Iowa

Intercomparison of French and U. S. Roentgen Ray Standards. A. Allisy, L. DeLaVergne, and H. O. Wyckoff. Acta radiol. **48:** 484–492, December 1957. (H. O. W., National Bureau of Standards, Washington, D. C.)

In order to accomplish the comparison of a new primary French standard at Ecole Normale Superieure (ENS) with those of other countries, a small transfer instrument was constructed. This consisted of a small ionization chamber, in which the air was ionized, and a capacitor and null electrometer to measure this ionization. It was designed to be portable and to require a minimum of set-up time. The precision was of the order of 0.1 per cent.

In July 1956, the transfer instrument was calibrated against the primary standard of the United States at the National Bureau of Standards. During September and October 1956, the transfer instrument was calibrated against the primary standard at ENS under identical conditions. In addition, a third calibration was made of the transfer instrument at NBS in October 1956. The intercomparison was effected in the 60- to 200-kv region. The agreement between the American and French measurements was excellent.

Four figures; 3 tables.

CHARLES M. GREENWALD, M.D.
Iowa City, Iowa

RADIOISOTOPES

Treatment of Recurrent Carcinoma of the Uterine Cervix with Cobalt 60. James F. Nolan, Juan Araujo Vidal, and John H. Anson. West. J. Surg. **65**: 358–366, November-December 1957. (Los Angeles Tumor Institute, 1407 S. Hope St., Los Angeles 15, Calif.)

The clinical courses of 121 patients seen at the Los Angeles Tumor Institute between July 1, 1948, and June 30, 1955, with a diagnosis of residual or recurrent carcinoma of the uterine cervix are reviewed for the purpose of evaluating secondary treatment. Eighty-nine patients in this group were found to have received some form of secondary treatment; in 16 this was primarily surgical and in 73 radiological. In 64 instances the diagnosis of recurrent disease was made by pathologic examination of biopsied or surgically removed tissues. In 25 cases recurrence was diagnosed from the clinical findings alone; 22 of these patients have expired and are considered to have died of the disease, while 3 are alive with palpable masses still inaccessible to biopsy.

Seven of the 89 recurrent cervical cancers were classified as Stage I, 32 Stage II, 36 Stage III, and 14 Stage IV. At the time of writing, 12 patients remained alive without evidence of disease; 12 were alive with persistence or recurrence, and 65 were dead of cancer. Seventeen of the patients with recurrent carcinoma were treated prior to April 1952, with 450-kv x-rays, with or without radium; all had died. Following acquisition of a 1,000-curie cobalt-60 teletherapy unit in 1952, and a 2-MEV Van de Graaff generator in 1953, 56 patients were treated with external megavoltage alone or in combination with radium. Eight were alive at the time of the report without evidence of disease.

In order to correlate the results with the dosages actually delivered, the time-dose convention was utilized. Calculated doses in roentgens at Point "A" in the pelvis for all patients were plotted against the treatment time in days. A study of the graph shows all 8 successes to lie at high dosage levels. A line beneath these was drawn at a slope derived from previous studies of time-dose relationships. This level of effective dosage was found to lie at 5,300 r in forty-two days. Thirty-four patients were treated at dosage levels falling above this line, with 8 successes and 26 failures. In contrast, all 39 patients treated at levels below this line were failures. Such findings indicate the probable truth of the theoretic consideration that the secondary treatment, to be successful, must be at least as vigorous as the primary treatment.

Of the entire group treated, 8 patients had major complications which could be attributed to radiation. Four of these had had primary surgical treatment two to nine months prior to the irradiation, and 4 had had radiotherapy from six to eighteen months previously. The 4 latter patients were treated secondarily with 2 MEV, cobalt 60 and radium, 450 kv and radium, and radium alone, respectively. Of the 8, 6 received high doses and only 2 fell into the low-dose group. The series has not been followed long enough to show all late complications. While these may in some instances be distressing, they must be judged in the light of the consequences of uncontrolled tumor.

Four charts; 3 tables.

Treatment of Polycythaemia Vera with Radioactive Phosphorus. James R. Fountain. Brit. M. J. **2**: 1335–1337, Dec. 7, 1957. (General Infirmary, Leeds, England)

Most of the common symptoms of polycythemia vera are due to the increased blood volume resulting from the red-cell mass. Improvement in symptoms under therapy parallels the approach of red-cell count and total red-cell volume toward normal levels. Radioactive phosphorus (P^{32}) at the present time is regarded as the agent of choice in treatment of this disease. Its selective action on the organs involved serves as the basis for its use. The fall in red-cell count is slow, and not usually apparent for several weeks after administration of P^{32}. Venesection provides an immediate measure to achieve decrease in blood volume when the diagnosis is made and relieve symptoms until the isotope becomes effective.

Since 1952, 47 patients with polycythemia vera had been treated with P^{32} at the Leeds Infirmary. Forty were followed for periods longer than three months. Three millicuries of P^{32} were given to all patients as the first dose. In 10 patients venesection was employed only to relieve symptoms. Patients were seen at monthly intervals after the first injection and, depending upon changes in symptoms, erythrocyte, leukocyte, and platelet counts, further doses of 3 mc were given when necessary. In approximately 90 per cent of cases an initial remission was induced with a total dose of 9 mc or less.

Thrombocytopenia is a potentially dangerous state and it was observed that the platelet count showed a tendency in some cases to fall before the red-cell count. In those instances where there was a precipitous decline, it has been the practice to withhold further therapy until platelets and leukocytes returned to normal numbers.

The longest remission in this series was thirty-seven months and the shortest two months. Of the 40 patients who were followed up, all but 2 had remissions after initial treatment. Subsequent remissions followed further courses of treatment.

Three tables; 2 graphs. JOHN F. RIESSER, M.D.
Springfield, Ohio

The Chronology of Events in the Development of Subacute Thyroiditis, Studied by Radioactive Iodine. P. Czerniak and A. Harell-Steinberg. J. Clin. Endocrinol. **17**: 1448–1453, December 1957. (Government Hospital, Tel-Hashomer, Israel)

Ten patients with subacute thyroiditis were subjected to repeated I^{131}-uptake tests with concurrent serum PBI determinations. The results indicate that the disease develops in four functional stages, which appear to correlate with previous histologic studies.

The first stage (stage of depression) corresponds to the two-month period in which stored thyroid hormone in the gland is sufficient to keep the patient euthyroid. It is characterized by low thyroidal I^{131} uptake (involving the entire gland), high urinary I^{131} excretion, normal or high PBI levels, and decreased TSH production. Presumably during this first stage the inflammatory infiltrate induces release of the stored hormone into the blood stream. By the third month of the

disease (stage of transition) the stored hormone is all utilized, and functional activity of the gland gradually changes: I^{131} uptake may be low, normal, or high: I^{131} excretion is normal or low; serum PBI values approach normal. During the third stage (stage of compensation), in the fourth month, the serum PBI values continue to fall, TSH production is enhanced, and I^{131} uptake increases. Finally, in the fourth stage (remission), the production of both TSH and thyroxine reaches the normal state of labile equilibrium, with normal values being found for I^{131} uptake, I^{131} excretion, and serum PBI concentration.

One graph; 3 tables. JAMES A. BURWELL, M.D.
Mercy Hospital, Pittsburgh

Exophthalmos and Localized Pretibial Myxedema in a Euthyroid Patient: Studies with Triiodothyronine. Monte A. Greer. J. Clin. Endocrinol. **17:** 1466–1471, December 1957. (Department of Medicine, University of Oregon Medical School, Portland, Ore.)

The thyroidal secretion rate of I^{131} was studied in a 61-year-old white female with marked exophthalmos and localized pretibial myxedema. The patient was euthyroid by ordinary clinical and laboratory criteria. Her initial secretion rate indicated a biologic half-life of four days, which put her in the most active group of thyrotoxic patients, in whom the average half-life is about seven days (average half-life in euthyroid patients is thirty days).

Upon the daily oral administration of up to 400 micrograms of triiodothyronine, the thyroidal secretion rate was not significantly suppressed. This abnormal response to administration of triiodothyronine has been found to be characteristic of active thyrotoxicosis.

Studies were also made of the penetration of labeled triiodothyronine into skin from a normal area as compared with skin from a myxedematous area of the leg. No significant difference between the concentrations in these two areas was found.

One graph; 1 table. JAMES A. BURWELL, M.D.
Mercy Hospital, Pittsburgh

Thyroid Dysfunction in Goitrous Children. Radioiodine Studies and Plasma Chromatograph Analysis for Thyroid Hormone. Ralph H. Kunstadter, Robert M. Kohlenbrener, and Leo Oliner. J. Dis. Child. **94:** 682–690, December 1957 (664 N. Michigan Ave., Chicago 11, Ill.)

At least three different metabolic defects are believed to be among the possibilities in the production of thyroid enlargement in children. In one group the gland is unable to synthesize iodine into organic combination, resulting in the rapid accumulation of administered ions of I^{131}. In a second group the thyroid can bind the iodide into mono- and diiodotyrosine but only small amounts of the end-product, thyroxine, are formed. The intermediate compounds, the iodotyrosines, are held in the gland, with only the labeled iodide and thyroxine present in the blood. The third group of patients have glands that are unable to deiodinate the hormone precursors and they are introduced as such into the circulation. The authors report in detail the cases of three boys, two of whom were brothers, with goiter and suggestive clinical hypothyroidism due to congenital errors of metabolism.

In each of the two brothers there was significant increase in the uptake of radioactive iodine and marked elevation in the PBI^{131}, the latter being 6.1 gamma and 9.5 gamma per 100 c.c., respectively. Chromatographic studies of the plasma in one case showed an iodinated tyrosine compound just before the iodide peak, as well as triiodothyronine and thyroxine. In view of the elevated uptake of I^{131} and PBI^{131} that indicated hyperthyroidism and the clinical impression of borderline hypothyroidism (with x-ray demonstration of retardation of bone age), the demonstration of an abnormal, iodinated, nonhormonal compound in the serum by chromatography is important and explains the situation.

The third child, an 8-year-old boy, was considered clinically euthyroid despite an enlarged thyroid and associated nodule. He was dwarfed and had other physical defects. While his I^{131} uptake was normal, radioactive studies showed elevation of the PBI^{131} and serum PBI. As in the case of the brothers, these findings indicated hyperactivity of the thyroid which was inconsistent with the clinical picture. Chromatographic studies here too indicated abnormal presence of thyroid hormone precursors. The nodule proved to be a benign adenoma.

Thus, children with congenital errors of thyroid metabolism may or may not manifest the usual clinical features of hypothyroidism. The serum PBI, I^{131} uptake, and PBI^{131} may prove inadequate to define the metabolic abnormality. Here the chromatographic analysis of circulating PBI^{131} compounds helps define the defect.

Six figures. SAUL SCHEFF, M.D.
Boston, Mass.

Experiences with I^{131}-Labelled Sodium Acetrizoate in Excretion Urography. Paul Cave, J. A. Rankin, and D. V. Mabbs. J. Fac. Radiologists **8:** 250–257, April 1957. (Royal Berkshire Hospital, Reading, England)

Excretion urography was carried out in 27 unselected patients with radioactive sodium acetrizoate (Diaginol). Geiger counter readings were taken at frequent intervals during the examination, over the liver, spleen, kidneys, and bladder. Fifteen patients receiving the labeled Diaginol returned twenty-four hours after the injection and counts were again made; in all, the retained amounts were of very low order. In 3 patients tested, for various reasons, three days after injection no significant count was obtained.

The first 14 patients were examined in the prone position. The supine position was found, however, to have certain advantages, and the remaining 13 patients were examined in that position.

Sixteen persons were normal. This group was subdivided into age groups of "under fifty" (9 cases) and "over fifty" (7 cases), and those who were dehydrated (9 cases) and who had been given a glass of water (about 100 c.c.) to drink fifteen minutes before examination (7 cases). Graphs of average counter readings from each group and subgroup were drawn. These showed a marked difference in form between the "under-fifty" and "over-fifty" groups and between the "with-water" and "without-water" subgroups in the "over-fifty" group. It is suggested that this finding may have a bearing on the management of excretion urography in elderly patients.

Four graphs; 2 tables.

The Use of Radioactive-Labeled Oral Fat in the Evaluation of Pancreatic Function. B. J. Duffy, Jr., and D. A. Turner. Cancer 11: 33–34, January-February 1948. (Georgetown University Hospital, Washington, D. C.)

The authors administered 50 mc of I^{131}-labeled triolein in 30 c.c. of olive oil to 12 patients suspected of having pancreatic cancer; 6 of the group were subsequently tested with similarly tagged oleic acid. All were fasting. The thyroid had been "blocked" the preceding night with 15 drops of Lugol's solution. Following a fat-free breakfast, blood samples were drawn at two, three, four, seven, and eight hours; the unbound inorganic I^{131} was precipitated, and the lipid-bound I^{131} was then determined in a well counter.

Admittedly this method cannot distinguish between pancreatitis and pancreatic carcinoma. It is merely a measure of insufficiency of pancreatic lipase. Oleic acid does not require lipase for alteration before absorption. Trioleic acid, however, being a triglyceride or neutral fat, must be broken down by the enzyme before it can be absorbed. Deficient absorption of triolein is therefore indicative of disturbed pancreatic function, though oleic absorption remains normal.

In the 12 patients with proved carcinoma of the pancreas studied, the test proved of value in pinpointing attention to this viscus.

SAUL SCHEFF, M.D.
Boston, Mass.

Pancreatic Exocrine Function; A Simplified Test Using Radioactive Fat Excretion. Richard P. Spencer and Thomas G. Mitchell. With the technical assistance of William Schulz. Am. J. Digest. Dis. 2: 691–695, December 1957. (National Naval Medical Center, Bethesda, Md.)

A relatively simple and accurate test is here described for determination of pancreatic exocrine function, which is useful in chronic pancreatitis and other conditions. By the administration of fat (triolein) tagged with radioactive I^{131}, the nonabsorbed fat can be easily determined from a stool specimen. Studies on normal subjects showed that less than 2.5 per cent of administered fat (triolein) is excreted unabsorbed in the stools.

The technic used by the author consisted of administering 1/10 ounce charcoal and 10 drops of Lugol's solution in water. The charcoal is used as an indicator, marking the completion of the passage of the material through the intestinal tract. Lugol's solution acts as a diluent to reduce the uptake of radioiodine by the thyroid. The patient then ingests the triolein I^{131}. Adult patients were given 25 microcuries in a carrier so made up that the final volume was 1 ml. per kilogram of body weight. The carrier was composed of peanut oil and water with an emulsifying agent added. A duplicate was prepared in identical fashion and used as a standard. The cup from which the patient drank the mixture was saved, since it contained residual activity that was subtracted from the standard to calculate the dose ingested.

Stools are collected until all traces of charcoal have disappeared. Calculation of the material excreted, expressed as per cent of the administered dose, was as follows:

$$\frac{\text{Counts in stool} - \text{background}}{\text{Counts in standard} - \text{counts in cup}} \times 100 = \text{per cent excreted.}$$

Patients with chronic pancreatitis, sprue, and other malabsorption syndromes showed a high excretion of triolein I^{131}.

Two tables.

J. S. ARAJ, M.D.
Toledo, Ohio

Isotope Transfer Test for Diagnosis of Ventriculosubarachnoidal Block. Robert L. Bell. J. Neurosurg. 14: 674–679, November 1957. (Neurosurgical Service, Kings County Hospital, Brooklyn, N. Y.)

An investigation of the use of the isotope transfer test for diagnosis of ventriculosubarachnoidal block was carried out in 25 unselected patients with clinical evidence of hydrocephalus. Radioiodinated (I^{131}) human serum albumin (RISA) was introduced into the ventricular system either by puncture of a lateral ventricle through an open fontanelle or a previously made cranial burr hole. The dosage employed was 100 μc. Immediately following injection the patient was placed in the erect position. The detector employed was a shielded Anton G-M eye probe. The total counts per minute were obtained along the cerebrospinal axis. These counts were then plotted *versus* the inverse square of the distance from the point of injection.

The evidence in 13 of the patients indicated that the hydrops was caused by obstruction of the aqueduct of Sylvius or at the portals of exit for cerebrospinal fluid of the fourth ventricle. In each of the 13 patients it was possible to demonstrate a block between the ventricular and subarachnoid system. In only 1 patient was there a complication following the intraventricular injection of RISA; in this instance hyperpyrexia developed shortly after the injection and continued for forty-eight hours. Eight hours after the injection of RISA the ventricular fluid was found to be clear and acellular. In 7 of the 25 patients ventriculoperitoneal shunts had been performed. The shunting tubes became blocked in 6 at variable periods following operation, as shown by the isotope transfer test.

The author concludes that the isotope transfer test is the easiest and simplest method of demonstrating a ventriculosubarachnoidal block. The test has also been found useful in determining the patency of tubes *in situ* that have been employed as shunts in arachnoidperitoneostomy and ventriculoperitoneostomy.

Four graphs.

Lympathic Scintigrams: A Method for Studying the Functional Pattern of Lymphatics and Lymph Nodes. Harold H. Sage and Benjamin V. Gozun. Cancer 11: 200–203, January-February 1958. (New York University College of Medicine, New York, N. Y.).

In this paper the authors present a method which they have used for demonstrating the functional pattern of lymphatics and lymph nodes in the intact dog.

The dogs were anesthetized with intravenous Nembutal Sodium and tracer amounts of radioactive gold (Au^{198}) were injected variously into lip, tongue, cheek, palate, and tonsil. Scintiscanning was started in both anteroposterior and lateral projections immediately after injection and continued three to six hours. Later recordings were made at twenty-four hours, forty-eight hours, and up to fourteen days.

Scanning of the cervical lymphatics is conveniently done in the dog, as the neck can be hyperextended so that chin and sternum are on the same horizontal plane. This region also is well suited since the dog has relatively few but constant lymph nodes.

The authors state that further studies are being done to determine how the lymphatic pattern and dynamics of lymph node pick-up may be altered by drugs, inflammation, and other physiologic and pathologic factors.

Seven scintigrams. DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Beta Radiation of the Feline Caudate Nucleus: Late Results. Orville T. Bailey, Svein Boyesen, and James B. Campbell. J. Neurosurg. **14:** 536–542, September 1957. (O. T. B., Indiana University Medical School, Indianapolis, Ind.)

A study was made of gross and microscopic changes eight to twenty-three months following implantation of Au^{198} and Pd^{109} spheres in the caudate nucleus of the cat. The spheres measured 0.86 mm. in diameter. The Au^{198} spheres delivered a dose of 0.5 to 2.05 mc beta radiation and the Pd^{109} spheres 2.88 to 3.50 mc.

Examination of many areas of the brain other than the caudate nucleus showed no lesions related directly to the radiation. It was felt that the approximation of a point source by the use of small spheres was an important factor in the sharp localization of tissue reaction.

Four photomicrographs.

Metabolism of ^{59}Fe-Dextran Complex in Human Subjects. A. J. Grimes and M. S. R. Hutt. Brit. M. J. **2:** 1074–1077, Nov. 9, 1957. (St. Thomas's Hospital, London, England)

A radioactive iron-dextran complex was administered intravenously and intramuscularly to normal and iron-deficient patients and measurements were made of its distribution and movement. After intravenous injection, the complex was cleared from the plasma by the reticuloendothelial system, and the iron was then utilized for hemoglobin synthesis. In iron-deficient patients there was substantially 100 per cent utilization of the administered dose. After intramuscular injection, approximately 60 per cent of the dose given was rapidly absorbed; thereafter clearance occurred only slowly.

These studies confirm the metabolic pathways taken by the iron-dextran compound previously investigated by serum-iron estimations in man and by histologic technics in animals. They further show that iron-dextran complex can be administered intravenously without reactions and that this results in a more rapid utilization of the injected iron when treatment is urgently required.

Four graphs; 3 tables.

Acute Leukemia After Radioactive Iodine (I^{131}) Therapy for Hyperthyroidism. Sidney C. Werner and Edith H. Quimby. J.A.M.A. **165:** 1558–1559, Nov. 23, 1957. (620 W. 168th St., New York 32, N. Y.)

The authors report 1 case of acute granulocytic leukemia from their series (number not stated) of hyperthyroid patients treated with I^{131}. The total dose was 2.1 mc in four months. The diagnosis of leukemia was established eighteen months after treatment. Symptoms had been present only three weeks.

The incidence of acute leukemia in the general population has been estimated to be about 1 per 20,000 patients per year. A conference in 1956, covering 13,000 patients from several clinics, revealed 4 cases of acute leukemia in 65,000 patient-years, or 1 case per 16,000 patient-years. Addition of this case changes the incidence to 1 case per 13,000 patient-years.

The figures quoted indicate that the association of leukemia and I^{131} therapy is no more than a chance one. It is recommended, however, that all cases of leukemia in patients receiving I^{131} therapy be recorded in detail to establish whether the association is more than coincidence.

One table. B. JAY HILL, M.D.
University of Michigan

RADIATION EFFECTS—PROTECTION

Radiation Hazards and What is Being Done About Them: A Symposium. Introduction and Statement of Problem. Edith H. Quimby. Am. J. Roentgenol. **78:** 944–945, December 1957. (College of Physicians and Surgeons, Columbia University, New York, N. Y.)

This brief note introduces a Symposium arranged for the purpose of summarizing for radiologists and others interested in this field the present state of knowledge with regard to radiation hazards as they apply to the individual and to the race, as well as to outline the plans for keeping such hazards at a minimum and to instruct radiologists in these matters. The information is designed to furnish reassurance that careful radiation workers are applying sound measures for lessening all radiation hazards. It must be kept in mind that it is not the radiation received by one individual which is the more important problem to be discussed, but that the average exposure to the entire part of the population between conception and the end of child-bearing is the area of special concern. Possible genetic implications are of prime importance.

Abstracts of the papers comprising the Symposium follow. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

The Shortening of Life by Chronic Whole-Body Irradiation. G. Failla and Patricia McClement. Am. J. Roentgenol. **78:** 946–954, December 1957. (G. F., 630 West 168th St., New York 32, N. Y.)

The authors utilize the experimental data of Lorenz *et al.* and the Gompertz function in an attempt to extrapolate data useful for application to man. Mathematical and statistical technics are utilized in the evaluation of the extrapolated data. Lorenz' experiments deal with chronic irradiation of mice with gamma rays from radium, with observations on shortening of life span so caused. It is noted that, irrespective of the mechanism by which radiation causes aging, the effect of such radiation is additive to the spontaneous or natural aging process.

The authors attempt to calculate a "fictitious" dose rate of radiation which will produce the same aging as occurs spontaneously. By the application of comparative values for life spans of men and mice, they calculate that a total-body dose of 0.64 r. per day will produce aging equivalent to spontaneous aging. It is further estimated that 1 r of accumulated total-body dose for chronic exposure at a dose rate not in excess of $^1/_2$ r per day will result in one day shortening of life for

man. It is noted that this value is much less than that calculated by Harding Jones, whose value is fifteen days per accumulated roentgen (Kaiser Found. M. Bull. **4:** 329, 1956). Presumably then, an "average man" occupationally exposed to roentgen or gamma rays over a period of forty-two years, (age 18 to 60), while adhering to presently recommended maximum permissible doses, will receive 210 r and accordingly his life span should be shortened by about two-thirds of a year.

The calculations and conclusions are most interesting. It is admitted by the authors that derived numerical values for man may have a considerable error but that probably the calculated range is a reasonably valid one.

Two graphs; 3 tables. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

The Genetic Basis for the Limitation of Radiation Exposure. Bentley Glass. Am. J. Roentgenol. **78:** 955–960, December 1957. (Department of Biology, Johns Hopkins University, Baltimore 18, Md.)

Genetic information is coded primarily in the deoxyribose nucleic acid portion of the chromosomes. Radiation-induced mutations result from damage to those chromosomes and are of two types. Microscopically detectable gross damage to the chromosome itself with breakage and rearrangement usually follows high acute radiation dosages. Mutations so produced are eliminated almost at once through early death of their carriers and are hence not likely to be important in long-term genetic problems. More significant to the population are the submicroscopic lesions resulting from radiation changes in the genes consisting in alterations of the sequence of their purine and pyrimidine bases. These so-called "point mutations" increase linearly with the radiation dosage. Hence, no threshold dose below which mutations are not produced is possible. The mutational effect remains linearly proportional to the ionization produced regardless of the quanta of the ionizing particles. Effects of such radiation mutations are essentially irreversible and it is for this reason that genetic changes become so important to future generations. Radiation acts blindly on the genes, not selectively, and is almost always deleterious. Crow believes that the mutational load is due primarily to detrimental recessive genes that cause no obvious visible abnormalities but will result in a slight reduction of life expectancy, a decrease in fertility, and an increase in various kinds of ordinary illnesses (Eugenics Quarterly **4:** 67, 1957).

The author attempts to estimate the tangible defects of a hereditary nature which may be expected from a "doubling dose" of radiation to the reproductive tissues. (At the present time this "doubling dose" to the gonads is estimated at 40 to 80 r per generation.) On the basis of an annual birth rate of 4 million live infants in this country and the assumption that the current gonadal dose to the population of the United States per generation is in the range of 4 to 5 r arising from medical and dental irradiation, the following conclusions are drawn: The spontaneous mutation rate accounts for about 80,000 defective babies per year. The currently estimated gonadal dose of $^1/_6$ r (167 mr) per year arising from medical and dental uses of radiation should average about 8,000 hereditarily grossly defective infants annually, if this same gonadal dosage is continued over one generation. It is noted that this is an increase of about 10 per cent over the natural or spontaneous mutation rate. It is admitted that these estimated values may vary over several orders of magnitude. Additional broad estimates are drawn for expected occurrence rates of nonlethal mutations of the hidden, recessive types. Such mutations can be expected to be much more numerous and much less readily recognizable.

One chart; 1 table. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Bone, Skin, and Gonadal Doses in Routine Diagnostic Procedures. J. S. Laughlin, M. L. Meurk, I. Pullman, and R. S. Sherman. Am. J. Roentgenol. **78:** 961–982, December 1957. (J. S. L., Memorial Center for Cancer and Allied Diseases, New York 21, N. Y.)

The general difficulties and problems encountered in accurate measurement of radiation doses to various parts of the body are discussed. Such factors as quality of the beam, quality dependence response of the radiation detector, directional response of the detecting chamber, and saturation effects for a particular chamber all have an important bearing on the readings obtained. When these variations are coupled with those arising from differences in field size, filtration, coning and diaphragms, and additional shields to various parts of the body, it becomes evident that wide variations in reported and recorded doses are to be expected. For such reasons, it is impossible to give a single dose, or even a narrow dose range, arising from any specific diagnostic procedure.

Summarized in tabular form are extensive data from several authors for radiation dosages resulting from many of the common diagnostic procedures. It is evident that reported doses vary over two or three orders of magnitude for even the most common examinations.

Data have been compiled for doses to the gonads and bone marrow resulting from natural background radiations. Exposures arising from cosmic rays, radioactive substances in earth and housing materials, and internal radioactive substances average about 100 plus or minus 21 mr per year to the gonads. Bone marrow doses arising from the same natural sources are about 135 plus or minus 30 mr per year.

The authors report observations in their own experiments relative to exposures to the skin, gonads, and bone marrow in the course of chest roentgenography, as determined from studies of a special phantom. The phantom is composed of unit density Presdwood into which an adult human skeleton has been fitted. Special low-density cork has been substituted in the thoracic area to simulate the lungs, and open spaces in the Presdwood-skeleton system have been filled with unit-density beeswax. Doses received by the testes, ovaries, skin of the chest, and marrow spaces of the cervical, dorsal, and lumbar spine are recorded for routine filming set-ups for postero-anterior views of the chest. Investigations include standard roentgenography and two types of photofluorographic units. For standard chest roentgenography at 72 inches TSD, it was found that the average active bone-marrow dose is about 1 mr. per mas. Photofluorographic technics under similar conditions yield 3.5 mr per mas. Shielding of the testes or ovaries with lead aprons and careful diaphragming of the beam to the chest results in a decrease of gonad doses by factors of 2 or 3. Actual doses to the gonads in chest filming are highly dependent on the degree of primary beam coning.

Some comments are made on the statistical difficulties

encountered in estimation of gonadal doses to large segments of the population.

[The charts and tables summarizing comparative skin and gonad doses from the common diagnostic procedures furnish useful data for all radiologists.]

Six figures; 14 tables. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Practical Suggestions for Reducing Radiation Exposure in Diagnostic Examinations. Lauriston S. Taylor. Am. J. Roentgenol. **78:** 983–987, December 1957. (Atomic and Radiation Physics Division, National Bureau of Standards, Washington, D. C.)

The author cites two important primary sources of information on the reduction of radiation exposure in diagnostic procedures. (1) Handbook 60 on *X-Ray Protection*, prepared by the National Commission for Radiation Protection in this country; (2) *Recommendations of the International Commission on Radiological Protection*. Selected rules and recommendations from these publications are quoted, and comments on their application and general importance are included. Well run radiologic departments in hospitals and offices have been found to comply reasonably well with the recommendations and rules given by these commissions. Radiologic installations in general practitioners' offices, on the other hand, generally do *not* comply. Diaphragming, coning, and other protective measures tend to be badly neglected in the dental field.

Special emphasis is given to adequate diaphragming and positioning as methods of effective dose reduction. Such features are particularly important in examinations of infants and young children.

"In closing one may unhesitatingly state that it is possible, with a little thought and understanding, to very appreciably reduce not only the gonadal dose of our population as a whole but the dose to the remainder of the body, where it can do no good and may do harm."

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Past and Present Radiation Exposure to Radiologists from the Point of View of Life Expectancy. Carl B. Braestrup. Am. J. Roentgenol. **78:** 988–992, December 1957. (Physics Laboratory, Francis Delafield Hospital, New York 32, N. Y.)

Earlier studies by March (Radiology **43:** 275, 1944) and by Shields Warren (J.A.M.A. **162:** 464, 1956. Abst. in Radiology **69:** 159, 1957) concerning the life span of radiologists have indicated considerable hazard in this specialty. However, both of these studies were based on the longevity of physicians who practiced radiology when exposure hazards were considerably greater than they are today. The present analysis is directed toward comparative studies of radiation exposures sustained from use of old-type roentgen installations and doses received from modern facilities. Conclusions are that the average radiologist using nonprotective equipment of earlier days sustained a dosage on the order of 100 r [total-body?] per year. With present modern equipment and protective methods, the accumulated dose is less than 1 r per year. Consequently, if reduction in life span is proportional to the dose received, it may be inferred that present day radiologists need not fear any significant future reduction of their life spans from irradiation.

Two figures; 3 tables. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Common Sense in Radiation Protection Applied to Clinical Practice. Robert S. Stone. Am. J. Roentgenol. **78:** 993–999, December 1957. (University of California School of Medicine, San Francisco, Calif.).

Development of the understanding of hazards from radiation exposure is reviewed from 1896 to date. Recommendations as to "permissible" or "safe" doses are traced from their inception in 1931 to the present day, with comment on the constantly decreasing "permissible or tolerance dose." It is pointed out that the arbitrary reductions in recommended maximum exposures have been made despite the fact that no one who stayed below the original upper limit of 200 mr per day has been found to have sustained appreciable damage.

Some general recommendations are made for decreasing gonadal exposures of the type likely to result in genetic damage. Such considerations include the following: Diagnostic exposures of children must be particularly carefully controlled because of long life expectancy and future parenthood. Fluoroscopic examinations of well babies should be strongly discouraged, if not actually prohibited. Pelvimetric examinations should not be performed without compelling medical indications. Such filming should be performed late in pregnancy or, if feasible, before the patient is pregnant at all. Consideration should also be given to the recommendation that all elective irradiation involving the area of the uterus or ovaries in women of childbearing age should be restricted to the two weeks immediately following the last menstrual period in order to preclude the possibility of irradiation of a very young fetus. Direct shielding methods, higher kilovoltages, close beam localization, fast films, etc., can all be utilized to decrease radiation dosages.

The author believes too much emphasis has been placed on the unfavorable aspects of irradiation and not enough on its great medical accomplishments.

Five tables. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

A Summary: Today's Problems in Radiation Hazards and What is Being Done to Control Them. Richard H. Chamberlain. Am. J. Roentgenol. **78:** 1000–1002, December 1957. (Hospital of the University of Pennsylvania, Philadelphia, Penna.)

The author emphasizes that there have been distortion and misplaced emphasis as to the extent of hazards arising from medical irradiation. Concluding the current symposium (see preceding abstracts), he states that: (1) exposure to human beings by ionizing radiation always involves some potential hazard—both somatic and genetic—regardless of designed beneficial purposes; (2) radiation dosage must be kept as low as possible compatible with the desired medical aims; (3) medical education and experience are needed for adequate decisions as to medical usefulness of radiations in various situations; (4) improvement in technics, instruments, and apparatus continues to reduce radiation exposures; (5) medical indications for any radiologic procedure are subject to changing factors and should be reviewed constantly.

New findings and new evidence, as well as more enlightened interpretations of radiation data, indicate the following important points: (1) that quantitative level of radiation which may significantly affect the genetic future of our population is now thought to be lower than formerly; (2) that there is no radiation exposure

threshold for genetic hazard; (3) that life-shortening effects must be included in considerations of radiation to individuals; (4) that low-level radiation exposures probably have greater somatic and genetic consequences during infancy and childhood; (5) that we must recognize that medical use of radiation is increasing and may well be approaching a point where its hazards become a population problem rather than an individual one; (6) that it is difficult or impossible to estimate precisely the amount of radiation exposure of large segments of the population; (7) that present exposures to radiation for medical and dental purposes can be considerably decreased by application of technics that are already available and known.

It is left to the conscience and training of the radiologist to answer the important questions: What apparatus is used for radiation exposure control; who is being exposed; to what part of the body is the exposure given; how much exposure is being given; why is radiation exposure being used. An awareness of the problems involved in medical radiation exposures and a conscientious attention to technical details will do much to control possibly hazardous radiation usages.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Radiation Genetic Hazards of a Population. Peter Ilbery. M. J. Australia **2:** 758–760, Nov. 23, 1957. (Atomic Energy Research Establishment, Harwell, Berkshire, England)

The author discusses the genetic hazards of radiation, concluding as follows:

"The truth lies somewhere between the most optimistic and the most pessimistic views, for enough has been said to show a 'measurable' trend due to the present increase in man-made radioactivity. However, the truth must await further experimentation and observation, and it must be realized that we are interpreting largely by analogy from animal to man. But we cannot afford to wait for the answer. We have to take a well informed guess and assess now the usefulness of radiation to the present population and its harmfulness to later generations—for there is no going back in heredity. A 5 per cent to 10 per cent increase in the mutation rate would not be an unreasonable figure.

"The American report has recommended that the population shall not be exposed to more than 10 r in the genetically significant period, and the Medical Research Council, although not recommending a specific maximum permissible dose level for the population, thinks that it is not likely to be more than twice the dose already received from the natural background and that it may possibly be lower. Thus the contribution from diagnostic radiology is certainly already approaching (and may even have passed in some countries) this maximum permissible level, and the nuclear programme must be allowed *Lebensraum* within this limit. The Adrian Committee is examining this question in the United Kingdom. It is not intended that 6 r or 10 r delivered to the whole population is to be regarded as a harmless limit, but rather as a level beyond which the hazards of the use of radiation may well outweigh its benefits. If the same benefits could be obtained with less radiation delivered to the population, this is to be desired.

". . .It is the radiologist's responsibility that the dosage rate of all equipment should be known and the operators educated in radiation protection.

"It is presumed that no one wants to see introduced the labour of keeping records for patients' exposure levels or restrictive legislation. Rather, the goal should be education in radiation protection, and further surveys of population exposure of the type carried out by Osborn and Smith in the United Kingdom [Lancet **1:** 949, 1956. Abst. in Radiology **68:** 793, 1957]."

Four graphs.

Ionizing Radiation and the Socially Handicapped. T. C. Carter. Brit. J. Radiol. **30:** 641–647, December 1957. (M. R. C.'s Radiobiological Research Unit, Harwell, Berkshire, England)

This paper is an attempt to estimate rather roughly the ultimate genetic effects upon the population of Great Britain due to ionizing radiation.

Data are presented to show that approximately one-tenth of human spontaneous mutations may be attributable to background radiation. Further data are used to arrive at an approximate figure which indicates that additional exposure to ionizing radiation due to modern practices will result in an increase in mutation rate by about one-tenth.

The handicaps which may be genetic in origin and which may be further increased by ionizing radiation are listed. The author concedes that much of the data is based upon speculation and incomplete knowledge but feels that an approach to the problem of possible genetic injury is an important consideration and should be investigated further.

Five tables.

J. A. GUNN, M.D.
Grand Rapids, Mich.

Studies on the Quantity of Radiation Reaching the Gonadal Areas During Dermatologic X-Ray Therapy. II. Methods, Quantitative Measurements, and Analyses of Some Important Factors Influencing the Gonad-Dose. Victor H. Witten, Marion B. Sulzberger, and William D. Stewart. Arch. Dermat. **76:** 683–693, December 1957. (New York University-Bellevue Medical Center, 550 First Ave., New York 16, N. Y.)

In Part I of this series (J. Invest. Dermat. **28:** 187, 1957), the authors presented the results of studies undertaken to determine how much ionizing radiation reaches the gonadal area of patients exposed to x-rays during the treatment of selected dermatologic disorders. Although the amount of radiation reaching the gonads was found to be small, at least compared with the doses received during other types of radiation therapy and during routine chest and heart fluoroscopy and x-ray examination of the hip, pelvis, abdomen, and lumbosacral area, further investigation seemed advisable.

The authors here report in more detail the measurements and findings which were only briefly covered in the earlier article and give additional findings on a larger series of patients. An attempt has been made to evaluate a large variety of factors which might influence the gonad dose of x-radiation. The following have emerged as among the most important of these: (1) the distance from the x-ray tube to the gonads; (2) the tilt of the tube in relation to the gonads; (3) the position of the patient; (4) scattered radiation from various sources; (5) leakage radiation from the tubehead. As a check, measurements were also made on an untempered pressed wood phantom. The doses and technics employed in the irradiation of the phan-

tom paralleled those actually used in the treatment of dermatologic patients.

The authors' studies showed that the amount of radiation reaching the gonads is dependent on many factors. According to their measurements, the total gonadal dose during single dermatologic treatments (or for a complete series of treatments) may be higher or lower than the suggested allowable limit (to the population as a whole) of 0.15 r (150 mr) per year, depending upon the conditions under which the radiation was administered. The dose, however, is less than the allowable maximum of 0.3 r (300 mr) per week for thirteen weeks or an average of 0.1 r (100 mr) per week throughout the year established for that small segment of the population which is occupationally exposed. Under exceptional circumstances, the gonad dose may be well in excess of either "allowable" dose in spite of the precautionary measures taken.

In the authors' opinion, these findings suggest that not only are critical review and evaluation of the indications and benefits of x-ray diagnosis and therapy necessary, but that the development and use of improved technics and equipment to reduce the x-radiation reaching the gonads are highly desirable. An investigation is being made of different methods of shielding, different shielding materials, positioning of patients, positions of tubehead and supports, and the construction and materials for x-ray tables. The use of therapeutic radiation of softer qualities is also being considered. To reduce the amount of radiation reaching the gonads during x-ray treatment is the joint responsibility of the designers and manufacturers of x-ray equipment, of the radiation physicist, and of the physician and radiation technician.

Six illustrations; 5 tables.

Radiation Protection in Dermatology. Anthony Domonkos and Gordon H. Cameron. Arch. Dermat. **76:** 694–698, December 1957. (115 E. 61st St., New York 21, N. Y.)

This study, covering a period of several years, was undertaken to determine the amount of radiation to which a dermatologist and his assistants were exposed in an active private practice. The office in which this investigation was carried out had available the following sources of ionizing radiation: three identical x-ray machines of modern design, a contact x-ray apparatus, 300 mg. of radium, and thorium X in alcohol solution. Film badges were worn intermittently by all personnel in the office, including those who were not engaged in administering therapy.

Results show that there was an undue amount of stray radiation when the x-ray apparatus was in use; in the corridors stray radiation was high. There was no lead lining in the walls. The total running time for the three x-ray machines for an eleven-year period amounted to only 1,036 hours, or an average of approximately two hours a week. This accounts for the fact that exposure of personnel was low, well below the accepted weekly permissible average dose of 100 mr. Despite this, remedial steps were taken to reduce the exposure to a still smaller amount.

Radiation Dosage in Dental Roentgen Examinations. Kristian Koren and Sem Maudal. Acta radiol. **48:** 470–472, December 1957. (Statens Radiologisk-fysiske Laboratorium, Rikshospitalet, Oslo, Norway)

The skin dosages produced by standard 45- and 70-kvp dental units were compared. Total skin dose at a given point was measured following exposure from 10 different angles, as in full-mouth roentgenography, by a Victoreen thimble chamber embedded in a phantom skull surrounded by wax to simulate soft tissue.

Only a few figures are given, demonstrating the importance of keeping the beam diameter to a minimum in order to reduce skin dosage as much as possible. The 70-kvp unit was found to produce the smaller dose, but only if fitted with a suitable diaphragm.

CHARLES M. GREENWALD, M.D.
Iowa City, Iowa

Radiation Damage Caused by Shoe-Fitting Fluoroscope. H. Kopp. Brit. M. J. **2:** 1344–1345, Dec. 7, 1957. (Finsen Institute, Copenhagen, Denmark)

A typical x-ray dermatitis with ulceration was observed on the dorsum and medial aspect of the right foot of a 56-year-old woman who had been employed for ten years as a clerk in a shoe store where a shoe-fitting fluoroscope was used. The apparatus was examined by a physicist, who determined that the beam intensity at the foot plate was approximately 10 r per minute and also that the device was poorly shielded. The dose to the abdomen of an adult customer was calculated to be approximately 1 r per minute and was probably greater in children.

The patient was in the habit of supporting her right foot on the platform of the device adjacent to the foot-opening during a fitting; she often placed her foot in the opening to show children that "it did not hurt," and occasionally would try new models of shoes under transillumination. She accordingly received large doses of radiation to the right foot.

It is felt that the hazards involved in the use of shoe-fitting fluoroscopes outweigh any possible advantages and that their use should be prohibited.

One photograph; one diagram.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Radiation Cancer: A Review with Special Reference to Radiation Tumours in the Pharynx, Larynx, and Thyroid. A. W. G. Goolden. Brit. J. Radiol. **30:** 626–640, December 1957. (M. R. C. Radiotherapeutic Research Unit, Hammersmith Hospital, London, W. 12, England)

To 24 cases of cancer in the deep tissues of the neck reported in the literature, the author adds 18. The distribution of the previous cases was as follows: pharynx 18, larynx 5, thyroid 1. The additional cases were all in the pharynx. The primary indications for irradiation were tuberculosis, adenitis, and thyrotoxicosis. All the tumors originated well within the previously irradiated area, but a few patients did not have signs of radiation damage to the skin. It is possible that radiation may have been one of several carcinogenic stimuli in these patients, and there are indications that tumors have developed in the pharynx when the carcinogenic effect of radiation has been augmented by other conditions favorable to the development of cancer.

The radiation-induced tumors of the pharynx show a similarity to spontaneous tumors in this location with regard to age, sex, and site, but an unusually high proportion develop between forty and fifty years of age. The latent interval following irradiation varied from

ten to thirty-five years, the mean being twenty-five years.

Twelve patients in whom cancer of the pharynx developed following irradiation for thyrotoxicosis were seen at Manchester between 1947 and 1954. It was shown by the author from a study of pertinent statistics in that area that this incidence is considerably greater than was expected.

Certain possible causative factors which might account for the development of cancer in the pharynx rather than the thyroid are discussed. "It seems possible that the thyroid has escaped radiation cancer because x-ray therapy did not seriously interfere with the production of thyroid hormone."

The author is of the opinion that our incomplete knowledge of the radiobiologic effect of I^{131} and the differences in its mode of application, dosage rate, and amount delivered make it untenable to predict effects identical with those noted in patients who have been treated with roentgen-ray therapy for thyrotoxicosis. More patients and a longer period of observation are required before the possible carcinogenic effect of I^{131} can be accurately assessed.

Six figures; 6 tables. H. C. JONES, M.D.
Grand Rapids, Mich.

The Effect of Field Size on the Dose to the Patient in Diagnostic Radiology. J. L. Haybittle. Brit. J. Radiol. **30:** 663–665, December 1957. (Addenbrooke's Hospital, Cambridge, England)

Measurements are reported demonstrating quantitatively the effect of field size on the dose to the patient in diagnostic radiology. Measurements described in this paper were made mainly at 80 kvp in a phantom 8 in. thick. Some of these measurements were made with a filter of 3.1 mm. Al, and some without filtration.

Results demonstrate that in abdominal and pelvic radiography the most important factor influencing the dose to gonads when they are outside the main beam is their distance from the edge of the beam. By comparison, changes in filtration, kilovoltage, and even in area have only a small effect. This means that field sizes should be kept to a minimum since, when a field is larger than necessary, its edge is probably closer to the gonads than is necessary. The point that the author emphasizes is that even a small field can deliver a large dose to the gonads if they are only just outside the beam.

One reservation has to be made in the plea for smaller fields. If a certain amount of information is required, *i.e.*, a certain area needs to be visualized, it is better from the scatter-dose point of view to cover the area with one large field than with a series of smaller ones. For example, if for an area 10 × 12 in. two 6 × 10-in. fields are used, the scattered dose in the midplane for the same film dose is about one-third greater than with one 10 × 12-in. field. With three 4 × 10-in. fields the scattered dose is two-thirds greater.

The conclusion is drawn that, although field size should be kept to a minimum, more attention should be paid to the proximity of the field edge to the vital regions, such as the gonads.

Six figures. J. P. CHAMPION, M.D.
Grand Rapids, Mich.

Protection by Diethyldioxystilbenedipropionate Against Leucopenia Due to Roentgen Therapy. L. Bellesia, E. Lusvarghi, C. Pasquinelli, and M. Dardari. J. Fac. Radiologists **8:** 239–249, April 1957. (Institute of Special Medical Pathology, University of Modena, Modena, Italy)

An investigation has been made of the use of the synthetic estrogen diethyldioxystilbenedipropionate as a protection against leukopenia occurring during roentgen therapy. Studies were carried out in 10 patients with lymphogranulomatosis, lymphosarcoma, or a malignant epithelial new growth. The results were compared with those in a group of patients suffering similar conditions both as regards the site and stage of disease and not treated by the estrogen. The estrogen was given every time there was a fall in the leukocyte count during roentgen therapy or at the beginning of treatment when the leukocyte count was already so low as to suggest that radiation was otherwise contraindicated or might have to be discontinued before a sufficient dosage had been given.

From their experience in the above cases, the authors conclude that diethyldioxystilbenedipropionate can prevent radiation sickness. Use of the stilbene with roentgen therapy permitted the administration of higher doses with consequent satisfactory results in cases in which leukopenia would have compelled premature interruption of treatment. Thus, it is possible (1) to prolong roentgen therapy and to give higher doses than usual because leukopenia appears more slowly and is less severe; and (2) to begin and complete roentgen therapy in cases of severe leukopenia when otherwise it would have been dangerous. The mechanism of the protection against leukopenia by the drug is still uncertain.

Sixteen charts are included showing the roentgen doses, leukocyte counts, surface doses, focus doses, white-cell counts, and other data in cases with and without stilbene.

Measurement of the Human Electroretinographic Roentgen Threshold Dose. V. Elenius and E. Sysimetsä. Acta radiol. **48:** 465–469, December 1957. (University Hospital of Turku, Finland)

Soon after the discovery of roentgen rays it was found that visual sensations, so called phosphenes, could be elicited if dark-adapted eyes were irradiated. This is believed to be due to direct excitation of the rods of the retina by the radiation.

The electrical responses of the retina to roentgen stimulation have been studied by measuring current flow between electrodes on the cornea and posterior pole of the eye. Response was found to be much greater in the eyes of animals in which the rods dominate, and the "action current" was greater in a dark-adapted eye. In the human retina the rods are numerous and a large amplitude b-potential is the principal part of the electroretinogram in a dark-adapted eye stimulated by light.

The authors felt that it was probable that human electroretinograms could be elicited with quite weak roentgen stimuli and that it would be of interest to try to measure the human electroretinographic roentgen threshold dose. The method employed is described. Only cataractous eyes were examined. One eye with a senile cataract was exposed to a total dose of 27.5 r; in other cases the total dose was under 10 r.

The threshold dose was found to be about 0.5 r, which is about 1,000 times greater than the subjective roentgen threshold dose for perception of the phosphene. The difference between these roentgen thresh-

olds is of the same magnitude as the difference between the electroretinographic and subjective light thresholds.

Five electroretinograms.

CHARLES M. GREENWALD, M.D.
Iowa City, Iowa

The Hemolytic Effect of Ionizing Radiations and Its Relationship to the Hemorrhagic Phase of Radiation Injury. Frederick Stohlman, Jr., George Brecher, Marvin Schneiderman, and Eugene P. Cronkite. Blood **12:** 1061–1085, December 1957. (National Institutes of Health, Bethesda, Md.)

This study was undertaken to determine whether red cell damage by irradiation could be demonstrated consistently prior to thrombocytopenia. In addition, the possible role of the extravascular cycle, incident to thrombocytopenia, in producing red cell injury was explored by determining the behavior of both extravasated normal cells and cells from irradiated animals upon their return to the general circulation. Adult mongrel dogs were used throughout the study. The irradiator was a Co^{60} source with 4π geometry. Red cell survival was measured with Cr^{51}-labeled cells.

Ionizing radiations were found to produce intravascular red cell damage in addition to the known loss incident to hemorrhage. With the chromium technic it was possible to demonstrate this damage as early as the first to the third postirradiation day. Evidence is presented to show that red cell damage is an indirect and progressive effect of irradiation.

Since there was a selective loss of Cr^{51}, it is suggested that chromium produced an additive damage to the cell. The possible implication of this observation in relation to Cr^{51} survival curves is discussed.

It was also determined that red cells which were recirculated following extravasation during the thrombocytopenic phase of radiation injury had a shortened survival, whereas normal cells, tagged and injected intramuscularly into normal recipients, survived normally on return to the general circulation. Cells collected from dogs one day after irradiation, tagged with Cr^{51} and then injected intramuscularly into normal recipients, showed a striking increase in the rate of destruction. Cells collected on the fourth postirradiation day were destroyed even more rapidly. These studies confirmed the early onset of radiation injury to the cell and its progressive nature and demonstrated the damage incurred as a result of passage through the extravascular cycle. As might be expected, there was also a shortened survival of red cells collected from the thoracic lymph of thrombopenic irradiated animals.

Twelve graphs; 3 tables.

Effects of X-Rays and Trypan Blue on Reticuloendothelial Cells. N. R. Di Luzio, K. A. Simon, and A. C. Upton. Arch. Path. **64:** 649–656, December 1957. (N. R. D., Department of Physiology, University of Tennessee, Memphis, Tenn.)

The study reported here was undertaken to evaluate further the influence of whole-body x-irradiation on the function of the reticuloendothelial system and its capacity to respond to sustained stimulation by repeated injections of Trypan blue.

Exposure of young adult male rats to 400 r of whole-body irradiation failed to inhibit the hyperplasia of reticuloendothelial cells induced by subsequent administration of Trypan blue.

The rate of removal of intravenously injected colloidal Au^{198} was not significantly depressed by 400 r whole-body x-irradiation or by prolonged daily administration of Trypan blue or by both treatments combined.

Uptake of colloidal Au^{198} was observed autoradiographically in Kupffer cells that previously phagocytized Trypan blue, but less gold was taken up by cells containing large quantities of Trypan blue than by cells containing little or none.

Rats given injections of Trypan blue developed a severe anemia and leukopenia, with erythrophagocytosis in lymph nodes and spleen and erythroblastosis.

Trypan blue-stained particulates were conspicuous in the epithelium of the proximal convoluted tubules of the kidneys.

Six photomicrographs; 3 tables.

Neoplasms in Monkeys (Macaca mulatta): Spontaneous and Irradiation Induced. Sidney P. Kent and John E. Pickering. Cancer **11:** 138–147, January-February 1958. (S. P. K., University of Alabama Medical Center, Birmingham, Ala.)

In 450 monkey autopsies, only 9 neoplasms were found, 3 of which appeared to have developed secondary to high doses of irradiation previously administered. This seems to confirm the belief that spontaneous neoplasms are rare in monkeys and that it is usually difficult to produce them experimentally.

Of the spontaneous neoplasms, there were 1 osteosarcoma, 1 malignant lymphoma of lymphocytic type, 1 pituitary adenoma, 1 case of multiple papillomas in the stomach, 1 subcutaneous hemangioendothelioma, and 1 fibroma of the adrenal. Of the others, 1 fibrosarcoma was seen following 3,000 r of Co^{60} gamma radiation; and 1 fibrosarcoma developed at a site where 2,000 r Co^{60} gamma radiation had been given. Finally, a glioblastoma multiforme was found in the parietal lobe brain substance after exposure of the head to 2,473 rep of thermal neutrons.

The low number of spontaneous neoplasms in monkeys may be related to the fact that in captivity their life spans are shortened considerably, and also, to some extent, to the care—or lack of care—with which autopsies are done.

The difficulty of producing neoplasms in monkeys experimentally with various carcinogens is fairly well known, but irradiation used in this connection has never been well evaluated. It is suggested that exposure to ionizing radiation may prove to be a satisfactory way to produce experimental tumors in these animals.

Five photographs; 9 photomicrographs; 1 table.

DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Fate of Skin Homografts in X-Irradiated Mice Treated with Homologous Marrow. Joan M. Main and Richmond T. Prehn. J. Nat. Cancer Inst. **19:** 1053–1064, December 1957. (J. M. M., Laboratory of Biology, National Cancer Institute, Bethesda, Md.)

The authors report experiments with mice homografted after x-radiation exposure (100 to 800 r) and homologous bone-marrow injection. (Homologous graft is defined as a transplant between animals of the same species but of different genotypes.)

Irradiated DBA/2 mice that had been treated with BALB/c marrow were successfully homografted with BALB/c skin. This experiment extended a previous observation, which showed that x-irradiated DBA/2

mice treated with (BALB/c × DBA/2)F_1 hybrid marrow were successfully homografted with BALB/c skin.

Irradiated mice that had been treated with homologous marrow frequently retained skin grafts from mice homologous to both the marrow-donor and the marrow-recipient strains.

Homologous skins were removed from successfully homografted mice. These mice accepted a second homograft of skin two months later.

The percentage of successful homografts between strains BALB/c and DAB/2 varied directly with the radiation and marrow-cell doses.

Mice exposed to low doses of radiation and injected with homologous spleen were homografted successfully thirty days later.

Irradiated mice that had been injected intravenously or intraperitoneally with homologous marrow retained a higher percentage of homografts than mice injected with marrow subcutaneously.

Mice that had been irradiated and grafted with skin immediately after the exposure were not successfully homografted thirty days later.

Autogenous strain DBA/2 skin and strain BALB/c skin homografts, which were removed from successfully homografted DBA/2 mice and grafted to previously untreated DBA/2 or BALB/c recipients, were found unaltered in transplantability requirements.

Caution should be used in extending these observations to other genetic combinations, as some of the strains used in these experiments carry the same allele at the histocompatibility-2 locus.

Four tables.

Physicochemical Properties of Circulating Red Blood Cells of Lethally X-Irradiated Mice Treated with Rat Bone Marrow. Takashi Makinodan and Norman G. Anderson. Blood **12:** 984–992, November 1957. (Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn.)

Since it has been demonstrated that, following transplantation of rat bone marrow into lethally irradiated mice, serologically detectable normal *rat* red blood cells exist in the presence of *mouse* serum proteins in the circulation, it was felt that a study of the physicochemical properties of rat red blood cells produced in the irradiated mouse would give some insight into the role of environment in cell growth and structure.

Two months after injection of rat bone marrow into lethally x-irradiated mice (so-called 950 r-RBM mice), 100 per cent of the circulating red blood cells were serologically of the rat type, indicating that the surface molecular configuration of red blood cells from the experimental mice is of the rat type.

The hemoglobin was found to be also very much like the rat type in its ease of crystallization, its alkali denaturation property, its electrophoretic property, and its tendency to undergo a paracrystalline state at low temperature.

These cells possessed dual osmotic properties; the relative hemoglobin concentration released when cells were lysed in water was more comparable to the rat type, but its temperature dependence was more comparable to the mouse type.

Four illustrations; 4 tables.

Preservation of Radiation Recovery Factor in Frozen Marrow. Joseph W. Ferrebee, Daniel Billen, Irene M. Urso, Wan Ching Lu, E. Donnall Thomas, and Charles C. Congdon. Blood **12:** 1096–1100, December 1957. (Children's Cancer Research Foundation, Boston 15, Mass.)

Investigations by the authors have shown a close similarity in the viability of human and rodent marrows stored in glycerol at −80° C. for six weeks, as determined by their rates of deoxyribonucleic acid (DNA) synthesis. The parallel effect of storage upon *in vivo* "seed" value, *i.e.*, the ability to repopulate bone marrow spaces destroyed by radiation, was measured by survival rates in lethally irradiated mice injected with stored bone marrow. The dose of frozen marrow required to produce recovery from the LD 100 of radiation (900 r) was found to compare favorably with the required dose of fresh, unfrozen marrow.

Since DNA synthesis is a satisfactory measure of rates of cell multiplication and since preservation is shown to affect DNA synthesis in human marrow to a lesser degree than in mouse marrow, it is concluded that the procedure used (−80° C. plus 15 per cent glycerol) is satisfactory for the maintenance of viability in human marrow.

One graph; 3 tables.

Amyloidosis in Mice Exposed to Daily Gamma Irradiation. S. Lesher, D. Grahn, and A. Sallese. J. Nat. Cancer Inst. **19:** 1119–1131, December 1957. (Division of Biological and Medical Research, Argonne National Laboratory, Lemont, Ill.)

This histologic nature of liver and kidney changes following amyloid infiltration is described and their relationship to irradiation is discussed.

The study of incidence and type of lesion was based upon examination of 144 LAF_1 mice given 6 r per day of gamma irradiation, 132 given 12 r a day, and 223 nonirradiated controls. All mice were one hundred days of age at the start of exposure. The desired gamma-ray doses were delivered by a 10 C Co^{60} source. The animals were exposed for duration of life to the indicated doses of irradiation and were autopsied at death. The liver and kidney condition was described grossly and representative tissue samples were fixed for histologic study. In a high percentage of both irradiated and control animals amyloid was found in the liver and kidneys.

The incidence of amyloid disease in irradiated and nonirradiated animals indicates a definite dose dependence. Amyloidosis first appears about nine months after the start of exposure to gamma irradiation. The initial appearance in control mice is at a comparable time but the peak incidence occurs earlier in the irradiated groups. It is of particular interest that amyloidosis is predominantly a disease of the midlife-span. During this period, the percentage of animals dying of amyloid disease was quite high; for example, in the 12 r per day series, approximately 50 per cent of the mice dying between 275 and 375 days after the start of irradiation had amyloidosis. Late in life the morbidity rate decreases sharply in all populations. The infiltrative nature of the disease produces the most severe degenerative sequelae in the kidney, although, in advanced cases, extensive atrophy of the hepatic cells and splenic follicles is observed.

Eight photomicrographs; 2 charts.

Biological Response to Mixed Radiations. Daniel S. Grosch, Robert L. Sullivan, and Leo E. LaChance. Nucleonics **15:** 64–66, December 1957. (Marine Biological Laboratory, Woods Hole, Mass.)

A study is reported of the combined sterilizing effects of internal x-rays and ingested beta emitters (P^{32} and Sr^{89}) on the ectoparasitic wasp. The sterilizing effect was estimated from the number of eggs laid by the wasps in the week following irradiation in comparison with the number laid by unirradiated controls.

The results indicate that a combination of external x-rays and ingested P^{32} "more nearly resembles the x-ray only effects than an additive effect." On the assumption that the x-ray and P^{32} effects are completely independent, the product of their survival percentages is shown to agree closely with the experimental values for mixtures of both radiations.

These effects are explained as follows. With combinations of rays the more intense component may do most of the damage; the majority of the sensitive cells, being irreversibly damaged by x-rays, could not be further harmed by beta rays. Lack of additivity implies that the biological mechanisms influenced are unrelated. It is possible that the lack of relation here may be entirely in time, since the x-ray dose is short and relatively intense whereas the dose due to ingested P^{32} is spread in time.

The authors conclude that, in order to protect organisms from *immediate* deleterious effects, one must guard particularly against sources of intense ionizing radiation.

One figure; 1 table. R. GARRETT
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Protection of Guinea Pigs Against Radiation Death by Cell-Free Mouse Spleen Extract. F. Ellinger. Science **126:** 1179–1180, Dec. 6, 1957. (Pharmacology Division, Naval Medical Research Institute, Bethesda, Md.)

Extract made from irradiated mouse spleen was injected into guinea-pigs. The guinea-pigs were then irradiated, and a reduction in the radiation-induced mortality was observed, in comparison with that in a similar series which had not received spleen extract. This gives strong support to the theory that a humoral factor (or factors) in the spleen is the essential agent in the protection against radiation-induced mortality afforded by spleen shielding, spleen transplantation, and spleen homogenates. It is indicated also, that the agent is not species-specific. This offers hope for the eventual identification and isolation of the protective factor.

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